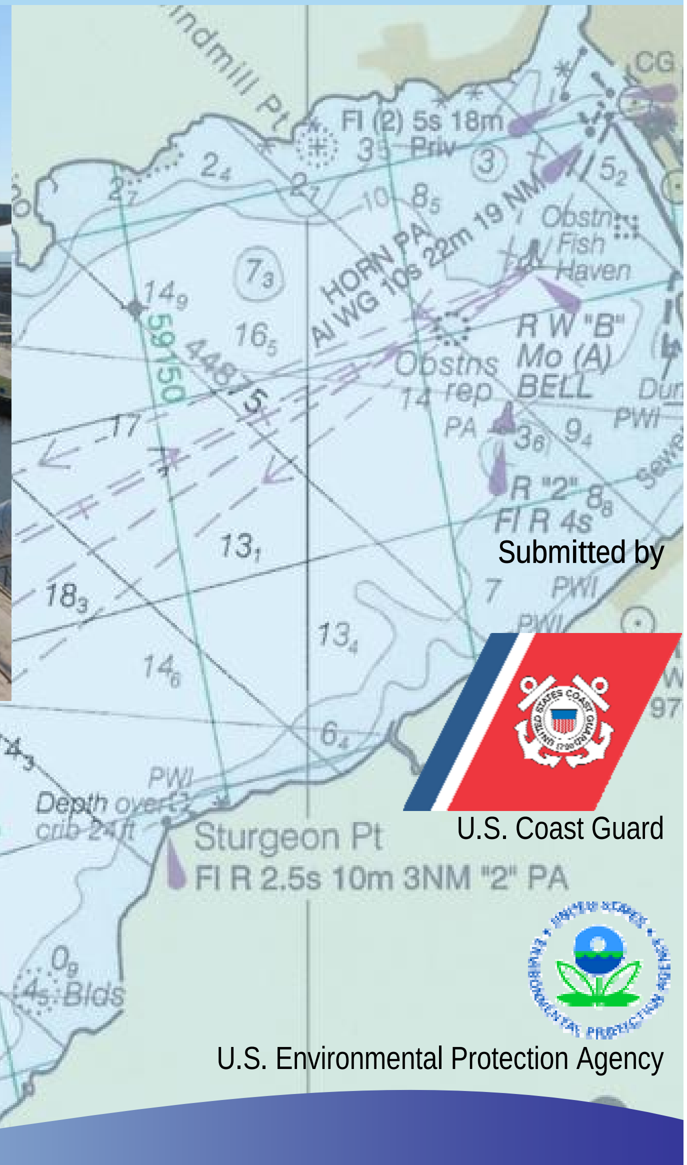
Draft
Environmental Impact Statement: U.S. Coast Guard Rulemaking for Dry Cargo Residue Discharges in the Great Lakes



Submitted by

U.S. Coast Guard

U.S. Environmental Protection Agency

May 2008

Draft Environmental Impact Statement: U.S. Coast Guard Rulemaking for Dry Cargo Residue Discharges in the Great Lakes

Prepared by

U.S. Coast Guard

in cooperation with

U.S. Environmental Protection Agency

May 2008

U.S. COAST GUARD DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR

DRY CARGO RESIDUE DISCHARGES IN THE GREAT LAKES

DOT DOCUMENT NUMBER: USCG-2004-19621

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This Draft Environmental Impact Statement (DEIS) provides an assessment of the potential environmental impacts associated with the proposed regulation of residue resulting from the shipping of dry cargo on the Great Lakes. The action would amend Coast Guard regulations in accordance with an existing policy that allows the sweeping of nontoxic and nonhazardous bulk dry cargo residues in limited areas of the Great Lakes, with new requirements for recordkeeping. The USCG has the authority to regulate such actions under U.S. jurisdiction under Section 623 of Public Law 108-293.

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12 May 2008 Date	Mr. Howard Hime Preparer	Howard L Hime	Chief, Office of Standards Evaluation and Development
12 May 2008 Date	Mr. Ed Wandelt Environmental Reviewer	Edward L. Sanders	Chief, Environmental Management Division

In reaching my recommendation on the USCG's proposed action, I have considered the information contained in this ~~DPEIS~~ on environmental impacts.

14 MAY 08 Date	Brian M. Salerno, Rear Admiral Responsible Official	ACTING CG-5 FOR BMS	Assistant Commandant For Marine Safety, Security, and Stewardship, U.S. Coast Guard

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13. ABSTRACT (Maximum 200 words)
The U.S. Coast Guard proposes to amend its regulations of the discharge of non-toxic and non-hazardous bulk dry cargo residues such as limestone, iron ore, and coal in limited areas of the Great Lakes. Five alternatives are considered with respect to their impacts to the environment from dry cargo residue discharges. The alternatives were analyzed with scientific sampling, modeling and testing methods to determine their effects on sediment, benthic, and pelagic Great Lakes environments, for water quality and biological resources; invasive species; threatened and endangered species; and essential fish habitat, as well as socioeconomic resources. Based on the analysis, the alternatives provide varying estimated levels of impact from dry cargo residue discharges, ranging from no impact to insignificant (minor) impact for water quality and biological resources, and from no impact to significant (major) for socioeconomic resources.

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Executive Summary

Background

A substantial portion of Great Lakes shipping involves "bulk dry cargos": principally limestone, iron ore, and coal, but also lesser quantities of other substances like cement and salt. During ship loading or unloading operations, small portions of these cargos often fall on ship decks or within ship unloading tunnels. This fallen dry cargo residue (DCR) can contaminate other cargos or pose safety risks to crew members. Traditionally, Great Lakes shippers have managed DCR by periodically washing both the deck and cargo unloading tunnels with water in a practice commonly known as "cargo sweeping." In order to reduce costs and minimize in-port time, ships typically conduct this cargo sweeping underway while transiting between ports, and the water and DCR together is washed off the ship and into the lake. Based on voluntary industry recordkeeping, the amount swept annually is small compared to the total amount of cargo transported (approximately 500 tons compared to 165 million tons transported).

Even though the reported amounts of DCR swept are relatively small, there is the potential for it to affect important resources within the Great Lakes. The U.S. Coast Guard currently regulates DCR sweepings under an Interim Enforcement Policy (IEP) issued in 1993 and authorized by Congress since 1998.

Purpose and Need

The purpose of the Proposed Action is to regulate nonhazardous, nontoxic DCR sweeping from vessels in the Great Lakes that fall under the jurisdiction of the United States. Congress has given the Coast Guard the permanent authority to issue regulations governing the sweeping of DCR in the Great Lakes, notwithstanding any other law. Future regulation must comply with the Coast Guard and Maritime Transportation Act (CGMTA) of 2004, Public Law 108-293, § 623. The CGMTA provides that Congressional authorization of Coast Guard's current IEP will expire September 30, 2008, but grants the Coast Guard permanent authority to promulgate regulations governing the sweeping of dry cargo residue to the Great Lakes. The proposed action would fulfill the Coast Guard's need to provide regulations. Since regulations for DCR could have an impact on the human environment, this Draft Environmental Impact Statement (DEIS) has been prepared in compliance with the National Environmental Policy Act (NEPA).

In exercising its authority, the Coast Guard seeks a balance between protecting the environment and facilitating commerce on the Great Lakes. This premise guided us to identify alternatives that meet the Purpose and Need.

Alternatives

The following five alternatives meet the Purpose and Need and are evaluated in detail in the DEIS.

Alternative 1—No Action

The No Action alternative is required by NEPA to form the basis of a comparison for other alternatives. Under the No Action alternative, the Coast Guard would not issue new regulations, and the IEP would expire in September 2008. After that date, existing laws and regulations banning all DCR sweeping would be enforced. DCR would not be allowed to be swept into waters of the Great Lakes; rather, it would have to be disposed of on land or added to the cargo hold.

For this DEIS, the No Action Alternative is unusual in that "no action" would allow the IEP to expire thereby prohibiting the discharge of any DCR sweeping. In other words, the No Action Alternative does not represent the current baseline conditions.

Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)—Coast Guard Preferred Alternative

The Proposed Action would continue current dry cargo sweeping practices, in accordance with the IEP. The alternative would also call for mandatory recordkeeping so that the CG could glean additional information about the practice of sweeping DCR. This information may be used for potential future regulations governing the sweeping of DCR.

Alternative 3—Proposed Action with Modified Exclusion Areas

This alternative consists of the Proposed Action plus modified exclusion areas. This would modify certain discharge areas currently allowed in the Great Lake by preventing DCR sweeping into environmentally sensitive areas. The alternative also includes several modifications to resolve inconsistencies in the IEP.

Alternative 4—Proposed Action with DCR Control Measures on Ships

In addition to provisions in the Proposed Action, this alternative would require structural, mechanical, and operational changes on ships to reduce the amount of DCR swept.

Alternative 5—Proposed Action with Shoreside DCR Control Measures

This alternative is similar to Alternative 4 except that it would require shoreside measures at ports to reduce the amount of DCR swept.

Each of these alternatives was developed and analyzed in terms of engineering conceptual design, operation, and estimated construction costs.

Affected Environment

The sweeping of DCR in the Great Lakes has been occurring for a century, and the existing conditions in the Great Lakes reflect the environmental impacts of the practice. An extensive literature review and site-specific investigation was conducted in order to define the existing conditions and predict impacts from each alternative. The investigations included chemical, physical, and toxicological analyses of the primary DCR types, detailed mapping of the Lake bottom in areas of historical DCR deposits, sampling and analysis of the Lake bottom in areas of DCR deposition and comparable reference areas, mathematical modeling and laboratory analyses of water quality, including nutrient enrichment and laboratory studies to determine the affinity of invasive mussel species for DCR. The evaluation revealed possible adverse impacts in the areas of sediment quality, water quality, biological resources, and socioeconomics.

Environmental Consequences

Environmental Consequences of Current Practices

The environmental consequences, or impacts, were determined by comparing the elements of each alternative to the existing conditions found in the Lakes. This process is normally a forecast or prediction for most EISs because the proposed action has yet to occur. However, the impact prediction process was aided for this DEIS because DCR has been swept for over a century, and impacts could be measured; thus all impacts are considered long-term. The impacts on environmental resources of any of the "action alternatives" (Alternatives 2 through 5) would not change existing conditions in the short term.

The impacts are not considered significant based on comparison to significance criteria and thresholds in the following five resource areas:

- **Physical Structure of the Sediment.** Sampling, mathematical simulations, and review of the scientific literature revealed that in historically higher-intensity DCR discharge areas there is a minor indirect adverse effect on the physical characteristics of the Lake bottom sediment, as indicated by a greater relative amount of larger-size particles than in comparable reference areas. The effect is not expected to change the benthic community of species and thus is not considered a significant impact.

- **Benthic Community Structure.** There was no direct evidence of DCR effects on the benthic community. However, it is possible that a change of the sediment physical structure could cause a small and localized shift in the relative abundance of the native species inhabiting the sediment. This is considered an insignificant (minor) adverse impact.

- **Invasive Species.** Invasive mussel species were observed in vessel track lines as well as comparable reference areas. There was the concern that DCR sweeping could contribute to the abundance and spread of zebra and quagga mussels because the substrate could gain additional hard surfaces due to certain types of sweepings. Invasive mussel species may have a preference to attach and create a habitat in hard-substrate environments. Laboratory studies revealed that invasive mussel species had an attachment affinity for DCR mixed with native sediments. The increased attachment, compared to native soft sediments, was more pronounced at the highest DCR densities estimated. Thus in areas of limited DCR sweeping, attachment preference would not be expected. If attachment surface, or substrate, is the limiting factor, the addition of DCR to the substrate could result in increased mussel density and distribution. Mussel densities in Lakes Erie and Ontario are already high, and continued sweeping of DCR is not expected to affect or exacerbate the populations in these Lakes. Other environmental factors for mussels, such as temperature, depth, and calcium concentrations prevent the establishment of invasive-mussel populations in Lake Superior. Based on our best knowledge at this time, the continued sweeping of DCR could have a minor indirect adverse impact by increasing invasive mussel species habitat in Lakes Michigan and Huron.

- **Protected and Sensitive Areas.** Currently, DCR sweeping is allowed in some protected and sensitive areas. The criteria established for significance recognized that any sweeping into protected and sensitive areas would result in direct insignificant (minor) adverse impact on protected and sensitive areas from the ongoing practices.

- **Socioeconomic Resources.** Based on current practices, there are no impacts from DCR sweeping on Great Lakes dry bulk shipping, industries that directly depend on that shipping, shipping lanes, port facilities, commercial or recreational fishing, or environmental justice (low-income or minority populations).

Environmental Consequences of the Proposed Action and Alternatives

The consequences, or impacts, of **Alternative 2—Proposed Action (IEP with Recordkeeping)** are considered the same as those described for current practices, since a similar DCR sweeping scenario has occurred in the Great Lakes for over a century, and with the IEP in place since 1993. The addition of recordkeeping would provide an incentive for vessel operators to pay attention to sweeping location and "good housekeeping" practices. This would lessen sweeping into areas where DCR sweeping is prohibited, which would in turn lessen the degree of impact, but the reduction is difficult to quantify. Socioeconomic impacts would be the negligible costs to shipping industry for mandatory recordkeeping.

The impacts of **Alternative 3—Proposed Action with Modified Exclusion Areas** on sediment physical structure, benthic community structure, and invasive species would be the same as those for the Proposed Action. There would be reduced, but not eliminated, sweeping into sensitive and protected areas under Alternative 3; thus the impact would be less than that for the Proposed Action but still considered an insignificant (minor) impact. The socioeconomic impact on shipping could be minor (insignificant impact) if vessels had to go out of their way to get to an area where they could sweep. There would be no impact to other socioeconomic resources.

The reduction in DCR sweepings from **Alternative 4—Proposed Action with DCR Control Measures on Ships** was estimated by comparing the average amount of DCR swept from newer vessels (presumed to have some control measures) to the average DCR sweepings from all vessels. The comparison revealed that there could be as much as 40 percent reduction in DCR sweepings by using control measures (identified in Appendix E), although this estimate is highly uncertain due to a lack of information. Alternative 4 would reduce the impacts to sediment physical structure, benthic community structure, and invasive species because less DCR would be swept. Since the reduction in impacts cannot be accurately quantified, the level of impact on these resources for the two alternatives is predicted to be insignificant (minor). The socioeconomic impact on shipping could be a minor cost (insignificant impact) to vessels that did not already have control measures.

The estimated reduction of DCR sweeping is even more uncertain for **Alternative 5—Proposed Action with Shoreside DCR Control Measures**. Lacking any reliable estimate of reduction under Alternative 5, the impacts are predicted to be insignificant (minor) and similar to those of the proposed action and Alternative 4 (insignificant impact). The socioeconomic impact on port facilities would be similar to those for shipping under Alternative 4; there could be a minor cost (insignificant impact) for port facilities that did not already have control measures.

Alternative—1 No Action would not have any impact on any of the environmental resources because there would be no sweeping of DCR. Observable change in existing conditions resulting from No Action would not be immediate. It would take at least 6 to 10 years for natural sedimentation to bury the historically deposited DCR and return sediment conditions to those found in comparable reference areas, removing potential mussel substrate. The socioeconomic impact for shipping, industries that directly depend on shipping, and port facilities would be major due to costs for vessel delay, collecting DCR, transferring it to shore facilities, pretreatment, and sewer usage charges for disposing to municipal wastewater systems.

Impact Mitigation

The only mitigation available for the insignificant (minor) adverse impacts to sediment physical structure, benthic community structure, and invasive species is a reduction in the amount of DCR swept. None of the four action alternatives alone can eliminate all DCR sweepings. Some combination of the four action alternatives could reduce sweepings further, but there are not enough data to precisely quantify this potential reduction. Consequently, the impact to these areas would remain an insignificant (minor) adverse impact under any of the four action alternatives or under any combination of them.

The insignificant (minor) adverse impact to the protected and sensitive areas could be mitigated by prohibiting sweeping into these areas. However, sweeping into protected and sensitive areas may not be totally eliminated because there may be transport of cargo totally within two areas (Green Bay and the Western Basin of Lake Erie); thus there is no opportunity for the ships to economically sweep DCR outside those areas. Prohibiting DCR sweepings for all the areas except the dredged shipping channels of Green Bay and Western Basin would lessen the impact substantially but not to the point of No Impact.

Comparison of Alternatives and Conclusions

All the action alternatives have similar impacts on environmental resources: no impact in most areas and insignificant (minor) adverse impacts on selected resources in others (Table ES-1). Impacts on Protected and Sensitive Areas can be substantially mitigated, but not to the point of No Impact.

There is only a minor adverse economic impact predicted for the Proposed Action, and a minor increase in the impact from the other action alternatives. The only major economic impact identified was the economic impact of No Action.

The area of most environmental concern identified in the EIS is the potential for continued DCR sweeping to worsen the existing invasive mussel problems in the Great Lakes. The factors that control mussel density and distribution are not fully known. Therefore, there is a degree of uncertainty in predicting that sweeping at current levels will increase the mussel infestation. Similarly, the degree of DCR sweeping reduction necessary to prevent a worsening of the problem cannot be specified with any certainty. The Coast Guard made substantial efforts to evaluate these impacts using accepted scientific methods, experts, existing information and theoretical approaches. The other issue identified in the EIS is the need for more information on the efficiency, effectiveness, and cost of DCR control measures, both on ships and shoreside. There is evidence that DCR sweeping can be reduced with equipment and procedures currently used in the shipping industry. However, the effectiveness of individual control measures cannot be determined. Also, there is a high degree of uncertainty in estimating the cost of the control measures.

Because of the uncertainty in effectiveness and costs of DCR control measures, the Coast Guard's preferred alternative at this time is Alternative 2, the IEP with recordkeeping on DCR control measures. This alternative will assist the Coast Guard in collecting additional cost, benefit, and effectiveness information on DCR control measures for possible future rulemaking.

TABLE ES-1
Comparison of Alternatives Based on Significance Criteria

Resource Category	No Action	Proposed Action—Coast Guard Preferred Alternative: Without Mitigation	Proposed Action—Coast Guard Preferred Alternative: With Mitigation	Modified Exclusion Areas	DCR Control Measures: Ship	DCR Control Measures: Ship with Mitigation	DCR Control Measures: Shore	DCR Control Measures: Shore with Mitigation
Sediment Quality								
Sediment chemistry	○	○	○	○	○	○	○	○
Sediment physical structure	○	◍	◍	◍	◍	◍	◍	◍
DCR deposition rate	○	○	○	○	○	○	○	○
Water Quality								
Water chemistry	○	○	○	○	○	○	○	○
Dissolved oxygen	○	○	○	○	○	○	○	○
Nutrient enrichment	○	○	○	○	○	○	○	○
Biological Resources								
Special-status species	○	○	○	○	○	○	○	○
Protected and sensitive areas	○	◍	◌	◌	◍	◌	◍	◌
Benthic community	○	◍	◍	◍	◍	◍	◍	◍
Fish, other pelagic organisms	○	○	○	○	○	○	○	○
Invasive species—Lake Ontario, Lake Erie, Lake Superior	○	○	○	○	○	○	○	○

○ No adverse impact.
◌ Post mitigation impact (between No and Insignificant adverse impact.)
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

TABLE ES-1
Comparison of Alternatives Based on Significance Criteria

Resource Category	No Action	Proposed Action—Coast Guard Preferred Alternative: Without Mitigation	Proposed Action—Coast Guard Preferred Alternative: With Mitigation	Modified Exclusion Areas	DCR Control Measures: Ship	DCR Control Measures: Ship with Mitigation	DCR Control Measures: Shore	DCR Control Measures: Shore with Mitigation
Socioeconomic Resources								
Invasive species—Lake Michigan, Lake Huron	○	◍	◍	◍	◍	◍	◍	◍
Waterfowl	○	○	○	○	○	○	○	○
Dry bulk carrier industry	●	○	○	◍	◍	◍	○	○
Industries directly dependent on dry bulk carriers	●	○	○	○	○	○	○	○
Commercial shipping lanes	○	○	○	○	○	○	○	○
Port facilities	●	○	○	○	○	○	◍	◍
Fishing	○	○	○	○	○	○	○	○
Environmental justice	○	○	○	○	○	○	○	○

○ No adverse impact.
◌ Post mitigation impact (between No and Insignificant adverse impact.)
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

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Abbreviations and Acronyms

APPS	Act to Prevent Pollution from Ships
BNL	benthic nepheloid layer
BOD	biochemical oxygen demand
CEQ	Council on Environmental Quality
CGMTA	Coast Guard and Maritime Transportation Act
COD	chemical oxygen demand
CWA	Clean Water Act
DCR	dry cargo residue
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FWPCA	Federal Water Pollution Control Act
GLERL	Great Lakes Environmental Research Laboratory
GLI	Great Lakes Initiative
GLNPO	Great Lakes National Program Office
GLWQA	Great Lakes Water Quality Agreement
IEP	Interim Enforcement Policy
IMO	International Maritime Organization
LCA	Lake Carriers Association
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
NEPA	National Environmental Policy Act of 1969
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPRM	Notice of Proposed Rulemaking
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
SOLEC	State of the Lakes Ecosystem Conference

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Acoustic impedance	A material property defined as the product of the density and velocity of ultrasound for a specific material. The differential effect of sound waves that allows differences in materials to be detected.
Acute effect	An adverse effect on any living organism that results in severe symptoms that develop rapidly; symptoms often subside after the exposure stops.
Algal bloom	Sudden spurts of algal growth, which can affect water quality adversely and indicate potentially hazardous changes in local water chemistry.
Anoxia	The absence of oxygen necessary to sustain most life. In aquatic ecosystems, anoxia refers to the absence of dissolved oxygen in water.
Anthropogenic	Derived from human activities.
Area of concern	An area recognized by the International Joint Commission where 1 or more of 14 beneficial uses are impaired or where objectives of the Great Lakes Water Quality Agreement or local environmental standards are not being achieved as a result of contamination.
Bathymetry	The measurement of water depth at various places in a body of water. The underwater equivalent of topography.
Benthic	Referring to organisms that live and/or feed on the sediment at the bottom of a water body, such as an ocean, lake, or river.
Benthic community	The assemblage of interacting organisms found at or near the bottom of a body of water, such as a lake, and residing generally in or on the upper part of lake bottom sediments or in contact with lake sediments much of the time. Includes a wide range of plants, animals, and bacteria from all levels of the food chain.
Bioavailable	Able to be absorbed and to interact readily in organism metabolism.
Biochemical oxygen demand	A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the biochemical oxygen demand, the greater the degree of pollution.

Biological productivity	The conversion of sunlight and nutrients into plant material through photosynthesis and the subsequent conversion of the plant material into animal matter. Biological productivity may apply to a single organism, a population, or entire communities and ecosystems.
Biomass	Total dry weight of all living organisms in a given area; often refers to vegetation.
Byssal threads	Small protein "ropes" extending from the muscular foot of a mussel. They are used to attach to substrate.
Chemical oxygen demand	A measure of the oxygen required to oxidize, without biological activity, all compounds, both organic and inorganic, in water. Most applications of chemical oxygen demand determine the amount of organic pollutants found in surface water (e.g., lakes and rivers), making it a useful measure of water quality. It is expressed in milligrams per liter, which indicates the mass of oxygen consumed per liter of solution.
Chlorophyll *a*	A pigment found in algae that is used as a surrogate for algal growth and the relative amount of algal activity in a lake.
Chronic effect	An adverse effect on a human or an animal in which symptoms recur frequently or develop slowly over a long period of time.
Clarity	The depth to which light penetrates water. Water clarity is a relative indicator of turbidity, since clarity decreases as turbidity increases.
Coaming	The raised framework around deck or bulkhead openings to prevent water from entering.
Community	In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest.
Critical Habitat	In the Endangered Species Act, the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Cycling	The flow of substances such as contaminants or nutrients among different places (e.g., atmosphere, water column, organisms) and through different chemical forms as a result of geological, chemical, and biological processes.
Deposition	The process by which material settles out of the atmosphere and accumulates in ecosystems.
Diatoms	A class of planktonic one-celled algae with rigid silica-composed cell walls. They are an important part of the food chain.
Discharge mixing zone	The area of water in which a discharge (e.g., dry cargo residue) first mixes with ambient water. The edge of the mixing zone is where the rate of mixing and dilution declines precipitously; beyond the edge, further dilution occurs only gradually.
Dissolution	The process by which a solid, gas, or liquid is dispersed homogeneously in a gas, solid, or, especially, a liquid.
Dissolved oxygen	The available oxygen in water, vital to fish and other aquatic life and also important in preventing conditions that result in odors. Dissolved oxygen is an important indicator of a water body's ability to support desirable aquatic life.
Diversity	The number of taxa present in an ecosystem or community and how evenly the density of organisms is partitioned among the taxa. A common measure of this variety, called species richness, is the count of species in an area.
Drainage basin	A water body and the land area that drains to it.
Dry cargo	Nonliquid cargos typically in a granular or aggregate form. Dry cargos include limestone and other clean stone, iron ore, coal, salt, cement, slag, grain, fertilizer, and wood chips.
Dry cargo residue (DCR)	Remnants of dry cargo shipments inadvertently deposited outside cargo holds during the loading and unloading of cargo. Dry cargo residues do not include residues of substances known to be toxic or hazardous, such as nickel, copper, zinc, or lead.
E. coli	Short for *Escherichia coli*, a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination.
Ecosystem	The interacting system of a biological community and its nonliving environmental surroundings.
Embayments	An area of water along the shore, semi-enclosed by land, where the shoreline indentation and thus the length of the embayment is longer than the width of the mouth opening to the lake.

Endangered species	Plants or animals threatened with extinction by anthropogenic or other natural changes in their environment. Requirements for declaring a species endangered are contained in the Endangered Species Act.
Enforcement area	Area within which sweeping of DCR is prohibited and penalized under MARPOL Annex V and Coast Guard regulations at 33 CFR Part 151. An enforcement area is generally stated in terms of a distance from land within which sweeping of DCR is not allowed.
Environmental justice	A requirement pursuant to Presidential Executive Order No. 12898 (issued February 11, 1994) that requires Federal agencies to "identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low income populations."
Epifaunal	Benthic organisms living on a substrate at the sediment water interface or on other benthic organisms.
Eutrophic	A water body, such as a lake, with high concentrations of plant nutrients, resulting in high productivity and excessive algal production. Eutrophication can be a natural process or can be accelerated by an increase of nutrient loading to a lake by human activity. See also "trophic state."
Exclusion area	See "enforcement area."
Floodplain	The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.
Great Lakes Water Quality Agreement	An agreement between the United States and Canada, first signed in 1972 and renewed in 1978, that specifically establishes water quality regulations with the goal of restoring and maintaining the chemical, physical, and biological integrity of the Great Lakes Basin ecosystem.
Habitat	The place where a population lives and its surroundings, both living and nonliving, whether human, animal, plant, or microorganism.
Hydrology	The science of the properties, distribution, and circulation of water.
Impervious surface	A surface, such as a paved road or compact soil, that does not allow, or allows only with great difficulty, the movement or passage of water.
Indigenous	Living or occurring naturally in a specific area or environment; native.

Inert	Having only a limited ability to react chemically; chemically inactive.
Inorganic matter	Chemical substance of mineral origin that does not contain carbon.
Interim Enforcement Policy (IEP)	A policy implemented by the Ninth U.S. Coast Guard District in 1993, amended in 1995 and 1997, that provides for the discharge of DCR in defined parts of the Great Lakes. Provided as appendix A.
Invasive species	Plant or animal species that are usually non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. They spread quickly and often uncontrollably.
Laboratory toxicity study	A test using live organisms to determine the adverse effect of a compound by exposing the organisms to the compound or a medium, such as sediment, including the compound.
Legacy contaminants	Contaminants from historical activities that remain in the sediment where they can subsequently enter the food chain and adversely affect human health and the environment.
Macroinvertebrate	A small organism that does not have a spinal column and may filter bottom sediments and water for food; large enough to be seen with the naked eye.
Mesotrophic	A water body, such as a lake, that contains moderate quantities of nutrients and is moderately productive in terms of aquatic plant and animal life. See also “trophic state.”
Mitigation	The process of taking measures to reduce adverse impacts on the environment, such as avoiding an action that may cause an impact; minimizing impacts by limiting the degree or magnitude of an action; repairing, rehabilitating, or restoring the affected environment; reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and compensating for the impact by replacing or providing substitute resources or environments.
Nautical mile	Equal to 1.15 statute miles
Nepheloid layer	Zone of water containing high concentrations of suspended sediment that is kept suspended by the interaction of current and sedimentation.

Nitrate	A nitrogen-containing compound, often used as a plant nutrient and inorganic fertilizer, that can exist in the atmosphere or as a dissolved gas in water and that can harm humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. Nitrate is found in septic systems, animal feed lots, agricultural fertilizers, manure, industrial wastewater, sanitary landfills, and garbage dumps.
Nitrite	A form of nitrogen that is intermediate in the process of nitrification.
Nonhazardous	Any material that does not pose a threat to human health and/or the environment and is not toxic, corrosive, ignitable, explosive, or chemically reactive. Any substance not designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or is otherwise released into the environment. See also "nontoxic."
Nonpoint source	Source of pollution from which pollutants are discharged over a widespread area or from a number of small inputs rather than from a distinct, identifiable source. Common nonpoint sources are activities associated with agriculture, forestry, mining, and development and construction, and dams, channels, land disposal, saltwater intrusion, and city streets. See also "point source."
Nontoxic	A chemical or mixture that does not present an unreasonable risk of injury to health or the environment. See also "nonhazardous."
Notice of Intent	A formal expression of intent to prepare an Environmental Impact Statement in connection with the development of new regulations or other proposed action.
Nutrient	A chemical assimilated by living things that promotes growth. The term generally is applied to nitrogen and phosphorus but also is applied to other essential and trace elements.
Nutrient Enrichment	The addition of nutrients (e.g., nitrogen, phosphorus, carbon compounds) from sewage effluent or agricultural runoff to surface water. Enrichment greatly increases the growth potential for algae and other aquatic plants.
Oligotrophic	Water bodies, such as lakes, with few nutrients, little organic matter and a high dissolved-oxygen level. See also "trophic state."
Operational DCR control measures	Method, procedure, or other nonstructural mean to reduce DCR, such as limiting the fill heights of cargo holds to below the deck elevation.

Organic matter	Carbon-based material contained in plant or animal matter. Dead organic matter accumulates in lake sediments where it decomposes and is recycled in the ecosystem. An overabundance of dead organic matter can lead to increased biochemical oxygen demand.
Ore	Mineral deposit containing a high enough concentration of at least one metallic element to permit the metal to be extracted and sold at a profit.
Outflow	The volume of water discharged from a water body in a certain amount of time.
Particulate matter	Very small solids suspended in water; they can vary in size, shape, density and electrical charge and can be gathered together by coagulation and flocculation. Also, fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.
Pelagic	The part of a lake that is not near the shoreline or lake bottom.
Pelagic organisms	Organisms found in open-water areas.
Persistent organic pollutant	Toxic chemical that adversely affects human health and the environment. Transported by wind and water, it remains for a long period of time in the environment and can accumulate and pass from one species to the next through the food chain.
pH	An expression of the intensity of the basic or acid condition of a liquid; may range from 0 to 14, where 0 is the most acid and 7 is neutral. Natural waters usually have a pH between 6.5 and 8.5.
Phosphorus	An essential chemical element that can contribute to the eutrophication of lakes and other water bodies. Increased phosphorus levels result from discharge of phosphorus-containing materials into surface waters.
Phytoplankton	Small, usually microscopic plant life (such as algae), found in lakes, reservoirs, and other bodies of water.
Plankton	Drifting organisms that inhabit the water column.
Point source	A source of pollution that is distinct and identifiable, such as a discharge from a pipe, ditch, ship, ore pit, or factory smokestack. See also “nonpoint source.”
Polychlorinated biphenyls (PCBs)	A class of toxic, persistent organic chemicals that bioaccumulate. The sale and new use of these chemicals, found in electrical transformers and capacitors and used in gas pipeline systems as lubricants, were banned by law in 1979. See also “persistent organic pollutant.”

Polycyclic aromatic hydrocarbons (PAHs)	A mixture of organic compounds released into the atmosphere as gases or particles during the incomplete combustion of organic material. Sources include cars, trucks, ships, aircraft, and industrial power generation. PAHs are identified as potential contaminants in drinking water that may have health effects. See also "persistent organic pollutant."
Pore water	The water filling the spaces between grains of sediment.
Pretreatment	The treatment of wastewater by commercial and industrial facilities to remove harmful pollutants before being discharged to a municipal or other treatment plant and avoid disruptions to the wastewater treatment process. In the context of this project, pretreatment facilities remove solids.
Probable effect concentrations	Concentrations of a chemical present in an environmental media above which adverse effects to organisms are expected to occur more often than not.
Propeller cavitation	Drag on a propeller caused by formation of air bubbles near fast-turning propeller tips, causing inefficiency and wear and tear on the propeller.
Reactive silica	A chemical that acts as a building block for diatoms, an algae.
Reference	As used in scientific investigations, an environmental quality or condition defined from as many similar systems as possible and used as a benchmark for determining the environmental quality or condition to be achieved or maintained in a particular system of equivalent type.
Resuspension	The process by which settled sediment particles and pollutants are dislodged and remixed back into the water column. Resuspension can occur as a result of storms, currents, organisms, and human activities such as dredging or shipping.
Retention time	A measure of the amount of times it takes for water to flow through a lake.
Risk	A measure of the probability that damage to life, health, property, or the environment may occur as a result of a given hazard.
Sediment	Soil, sand, and minerals washed from land into water, usually after rain. Also, the unconsolidated materials that settle at the bottom of the Great Lakes, consisting of particles of sand, clay, silt, and other substances derived from eroding soil and from decomposing plants and animals.
Sedimentation rate	The amount of sediment that settles out of the water column to the lake bottom over a certain period.

Sensitive habitat	Any area in which plant or animal life is either rare or especially valuable or any habitat that supports endangered or threatened species.
Shipping lane	An established route for large cargo-carrying vessels along which ships are advised to navigate because the route has been specially examined to ensure as far as possible that it is free of dangers. Typically shown on navigational charts. Not enforced by law due to weather, safety, or other issues that may cause a vessel to reroute.
Sidescan sonar	System that creates image maps of the seafloor from reflected sound waves.
Significance	Significance is determined by the intensity or severity of an impact (the effect of discharging a chemical to the environment, for example) and the context in which it occurs. Criteria for evaluating potential impacts and determining their significance are outlined by the Council on Environmental Quality in the definition of "significantly" (40 CFR 1508.27).
Socioeconomic	Of or involving social and economic factors.
Spawning areas	Fish-breeding areas.
Special protection areas	Established in the IEP to protect sensitive ecological resources, such as fishery spawning and nursery grounds, and drinking water supply intakes.
Statute mile	1 statute mile = 0.87 nautical mile.
Stormwater runoff	Rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces but instead flows onto adjacent land or watercourses or is routed into sewer systems. Includes surface runoff and snowmelt runoff.
Structural DCR control measure	Mechanical device or other physical control that directly prevents or captures DCR on a ship deck or in a ship tunnel.
Substrate	Bottom sediment material in a natural water system.
Sump	A protrusion from the bottom of a cargo tank shell into which excess water is drained and collected.
Sweepings	Also known as dry cargo residue.
Taconite	Low-grade iron ore that is processed into pellets approximately 1 centimeter in diameter.
Tailings	Residue of raw material or waste separated out during the processing of crops or mineral ores.

Taxa	A grouping of organisms, as a species, genus, or family, given a formal taxonomic name.
Thermocline	An area where water temperature changes rapidly with depth, creating a barrier that prevents the upper and lower waters of a lake from mixing.
Threatened species	Any species likely to become "endangered" within the foreseeable future throughout all or a significant part of its range. A species of wildlife or plants listed as "threatened" pursuant to a specific act (e.g., Endangered Species Act, CITES).
Threshold effect concentration	The concentration below which adverse effects are not expected to occur. Sediment screening value from MacDonald et al. (2000).
Topography	The physical features of a surface area, including relative elevations and the position of natural and anthropogenic features.
Trace metals	Metals present in small concentrations.
Track lines	The actual path a vessel travels; depending on conditions, may be the same as a shipping lane. See also "shipping lane."
Transshipments	Refers to movement of cargo between facilities at a single port or city.
Trophic state	A classification system and measure of the biological productivity in a body of water. Aquatic ecosystems are characterized as oligotrophic (low productivity), mesotrophic (medium productivity), or eutrophic (high productivity).
Turbidity	A cloudy condition in water due to suspended silt or organic matter. See also "clarity."
Type-E botulism bacterium	A common bacterium (*Clostridium botulinum*) that produces a toxin under certain conditions, namely the anaerobic (oxygen-free) conditions that occur in dead organisms. When ingested, it can be fatal.
Veliger	The early life stage of a mussel during which they are active swimmers and photopositive (i.e., respond positively to light).
Watershed	The land area that drains into a stream or water body; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point. See also "drainage basin".
Zooplankton	Small (often microscopic) free-floating aquatic animal life.

CHAPTER 1

Introduction

This Draft Environmental Impact Statement (EIS) is in support of the Coast Guard's Congressionally authorized rulemaking for the regulation of sweeping of dry cargo residue (DCR) resulting from the shipping of dry cargo on the Great Lakes. As described in subsequent sections of this document, the environmental impacts of various alternatives are identified and evaluated to assist the Coast Guard in finalizing the rulemaking activity.

This Draft EIS represents the Coast Guard's compliance with the National Environmental Policy Act of 1969 (NEPA), which is mandated because the promulgation of DCR rules is a major Federal action with potential impact to the environment. The U.S. Environmental Protection Agency (EPA), at the Coast Guard's request and because of its special expertise on the Great Lakes and water quality issues, is participating in the NEPA process as a cooperating agency. As such, EPA has been involved in the development of this EIS. Chapter 1 provides a discussion of background and history on rulemaking and shipping; the Purpose and Need of the rulemaking; public involvement, scoping, and the Notice of Intent (NOI); and the scope of the Draft EIS.

1.1 Background and History

Limestone, taconite, coal, cement, salt, and other dry cargoes have been shipped on the Great Lakes for many decades. The shipment and use of such cargo for manufacturing have been major economic and societal factors for many cities and industries along the Great Lakes. As cargo is loaded and unloaded, small amounts inadvertently fall on the decks or within the storage areas of the large (up to 1,000 feet long) vessels that transport the dry cargo. During unloading, the residues may fall off conveyor belts in tunnels under the vessel's deck.

The DCR can pose safety hazards to ship crews, who may slip on dust or small particles on decks or in unloading tunnels. To alleviate this safety hazard, the DCR is washed or swept from the deck or pumped overboard from the unloading tunnels in the lower hull. Sweeping also is conducted to prevent cross-contamination with other cargos, which often change from trip to trip.

In response to regulatory changes described in Section 1.1.1, Congress authorized the Coast Guard to begin environmental assessment activities necessary to support new regulatory action. This Draft EIS assesses the potential environmental impacts of implementing and enforcing a program to regulate DCR sweepings by vessels operating in U.S. jurisdictional waters of the Great Lakes and U.S. vessels operating anywhere in the Great Lakes. Its purpose is to ensure that environmental information is available to public officials and citizens before decisions are made and actions are taken. The NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences and take actions that protect, restore, and enhance the environment.

The specific intent of this EIS is to provide analysis to inform the Coast Guard's decisions on regulating DCR sweeping; on the likely environmental consequences of the Proposed Action and alternatives; to inform the public and provide opportunities for public involvement and comment; and to comply with NEPA requirements.

The sections below describe the following:

- Regulatory background for sweeping of DCR on the Great Lakes
- Fleet composition of the dry bulk carrier industry as it operates under the Interim Enforcement Policy (IEP) (IEP is attached as Appendix A)
- Primary cargoes shipped and regulated by the IEP
- Cargo-handling and movement of dry bulk cargoes with the IEP, including recordkeeping
- Source and quantity of dry bulk cargo residues and sweeping

1.1.1 Regulatory Background

Federal, State, and international regulations address water quality protection in the Great Lakes and potentially relate to rules addressing DCR. The Federal Act to Prevent Pollution from Ships (APPS) 33 U.S.C. §1901 et seq. prevents discharge of operational wastes (which is interpreted to include DCR) to internal waters of the United States. Since the U.S. waters of the Great Lakes lie entirely within the U.S. baseline, they are considered to be completely internal waters. Thus a strict interpretation of APPS would prohibit sweeping of DCR anywhere within the Great Lakes. A Coast Guard regulation, 33 CFR 151.66, implements APPS by banning the discharge of garbage, including operational wastes, into the internal waters of the United States (including U.S. waters of the Great Lakes).

The Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada, first signed in 1972 and renewed in 1978, specifically establishes water quality regulations with the goal to restore and maintain the chemical, physical, and biological integrity of the Great Lakes ecosystem. This agreement also requires the United States and Canada to develop measures to control the discharges of vessel wastes. Under the GLWQA, Canada and the United States were charged with developing compatible regulations governing sweepings.

State and local laws may also relate to DCR sweeping in the Great Lakes. For example, as the Michigan Department of Environmental Quality pointed out in a letter submitted during scoping for this EIS, the discharge of litter from water craft or commercial vessels is prohibited under Part 95 of the Michigan Natural Resources and Environmental Protection Act of 1994. That act defines litter, as waste material, debris, or other foreign substance of every kind and description, and thus could apply to DCR.

Concerned that the strict prohibition of DCR sweeping could have a severe economic impact on Great Lakes shipping, the Coast Guard's Ninth District adopted an IEP in 1993. The IEP sought to reasonably balance commercial requirements with necessary safeguards for Great Lakes environmental protection. Also, the IEP did not allow sweeping of materials known to be toxic or hazardous. The IEP provided for the sweeping of dry cargo residues in defined portions of the Great Lakes that are relatively far from the shore and that avoid environmentally sensitive areas, which are generally at least 3 miles from shore. The IEP applies only to dry cargo residues, and does not alter the strict prohibition of any discharge of oily waste, untreated sewage, plastics, dunnage (packing materials), or other items commonly understood to be "garbage," from vessels on the Great Lakes. The Ninth District periodically reissued the IEP through 1997 (Appendix A).

Beginning in 1998, Congress legislatively authorized continuation of the IEP. This authorization was renewed in 2000 and 2004. As part of the authorization, Congress directed the Coast Guard to continue enforcement of the IEP, to evaluate the environmental impacts of the practice, and to promulgate regulations for the sweeping of DCR. In 2004, Congress added that this regulatory authority can be exercised "notwithstanding any other law," [Public Law 105-383, 112 Stat. 3411& 415, Nov. 13, 1998] but also provided that the IEP would expire not later than September 30, 2008. Without the Congressional preemption of other laws, current Federal environmental statues, if strictly enforced, would prohibit DCR sweeping. Neither the existing IEP nor any of the proposed alternatives in this DEIS preempt State laws that regulate DCR sweeping.

In 2004, Congress also authorized the Coast Guard to begin environmental assessment activities necessary to support new regulatory action. With the development of the environmental evaluation included in this EIS and promulgation of rules governing DCR and supported by this EIS, the Congressional directive will have been met. Also, Canadian officials have been consulted and the Canadian Coast Guard has adopted the IEP. Thus the requirements of the GLWQA have been met. The concurrence of the Canadian Coast Guard indicates conformance with Canadian law.

1.1.2 Fleet Composition and Ports of Operation

The Great Lakes dry bulk carrier industry is affected by APPS, the IEP, and rulemaking alternatives under consideration. These rules affect U.S. flag vessels and other vessels operating in U.S. waters, regardless of ownership and country of origin, and therefore are discussed below.

During the 2006 shipping season, 55 U.S.-flag ships and 70 Canadian-flag ships carrying dry bulk cargoes operated on the Great Lakes (Table 1-1). These numbers include ships that have been converted to combined barge/tug vessels.

Non-Canadian foreign vessels, which enter and exit the Great Lakes during each voyage, constitute a small part of Great Lakes dry bulk shipping transportation and are not included in Table 1-1. For example, the non-Canadian foreign-flag bulk carrier fleet consists of about 12 to 20 vessels, making approximately 350 trips with grain per year (as compared, for example, to over 5,000 shipments of taconite) (USCG, 2002). Vessels in long-term lay-up also were excluded from the information summarized in this section. Barges and tugs used for inner harbor transport were not included in the IEP as they do not routinely sweep, and are not part of this EIS.

Four companies handle the majority (75 percent) of Great Lakes U.S.-flag dry bulk cargo shipments: American Steamship Company, Great Lakes Fleet, Interlake Steamship Company, and Lower Lakes Towing and Lower Lakes Transportation. Similarly, four companies handle the majority (80 percent) of Canadian shipments: Algoma Central Corp., Canada Steamship Company, Groupe Desgagnes, Inc., and Upper Lakes Group, Inc.

TABLE 1-1
Active Great Lakes Dry Bulk Carriers (2006)

Company Name	Vessels	Notes
U.S. Vessels		
American Steamship Company	18	—
Central Marine Logistics	3	—
Great Lakes Fleet	8	—
Hannah Marine Corps	2	—
Inland Lakes Management	1	Five vessels in long-term lay-up not included in count. Vessels may sail if demand for cement increases
Interlake Steamship Company	9	One vessel in long-term lay-up not included in count
Keystone Lakes Shipping	1	—
KK Integrated Shipping, LLC	2	One vessel in long-term lay-up not included in count
LaFarge North America Inc.	2	—
Lower Lakes Towing / Lower Lakes Transportation	7	Lower Lakes Towing and Lower Lakes Transport is a Canadian company with U.S. affiliates
Upper Lakes Towing, Inc.	1	—
Van Enkevort Tug and Barge, Inc.	1	—
Total U.S. Vessels	55	
Canadian Vessels		
Algoma Central Corp.	17	Two vessels in long-term lay-up not included in count
Canada Steamship Company	14	—
Great Lakes Transport Ltd.	1	—
Groupe Desgagnes, Inc.	8	One vessel in long-term lay-up, and two vessels trading on the St. Lawrence River not included in count
K-Sea Canada Corp.	1	—
Lower Lakes Towing / Lower Lakes Transportation	4	Four of the 11 ships owned by the company are operated by the Canadian branch of the company
McKeil Marine Ltc.	2	—
Pere Marquette Shipping	1	—
St. Marys Cement	2	—
Upper Lakes Group, Inc.	17	Two vessels in long-term lay-up and two in permanent lay-up not included in count
Voyageur Marine Transport Ltd.	3	—
Total Canadian Vessels	70	
Total U.S. and Canadian Vessels	125	

Sources: LeLievre, 2006. www.boatnerd.com, 2007. G. Kirkbride, personal communication, 2007.

U.S. ships operate out of roughly 70 U.S. ports in Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York, with the greatest number of ports, 40, in

Michigan. Canadian-flag ships operate out of 35 ports in Ontario and Quebec, with most of those ports in Ontario.

1.1.3 Primary Dry Bulk Cargo Shipped under Regulation of the IEP

Most Great Lakes carriers transporting dry bulk cargoes move the cargo between Great Lake ports. Taconite (primarily in the form of pellets), coal, and limestone are the primary commodities transported, with cement, grain, gypsum, millscale, salt, sand, and slag transported to a lesser extent. Extensive information on the cargoes and transport quantities has been previously documented in *A Study of Dry Cargo Residue Discharges in the Great Lakes* (USCG, 2002), *Study of Incidental Dry Cargo Residue Discharges in the Great Lakes* (USCG, 2006), and in annual reports compiled by the Lake Carriers' Association (LCA) and the Canadian Shipowner's Association. Table 1-2 summarizes the U.S. commodity data. Although there are more Canadian-flag ships than U.S.-flag ships, there are fewer Canadian ports and lesser quantities of dry cargo transported. Consequently, the focus of the data in Table 1-2 is on U.S. transport of dry bulk cargo.

Previous analyses of the Great Lakes dry bulk cargo industry indicated many of the shipments support the steel industry, which requires large amounts of taconite, coal, and limestone. On average, 95 percent of the U.S.-flag dry bulk cargo comprises these three cargoes. Canadian vessels have a similar cargo composition, but with a greater amount of coal. Other Foreign vessels transport dry bulk commodities within the GL to a lesser degree than US and Canada. Of the three cargoes, limestone has the most diverse customer base and is used not only by the steel industry but also by the construction industry as an aggregate stone.

The three primary cargoes are shipped between the following major U.S. ports (USCG, 2006):

- Taconite—Iron ore is mined in Minnesota and Michigan, and processed taconite pellets are transported from Duluth-Superior and Two Harbors Minnesota, and shipped to ports near major U.S. steel mills (for example, Lorain and Toledo, Ohio; Gary and Indiana Harbor, Indiana).

- Coal—Eastern and western coals are shipped through the Great Lakes. Typical shipping origination points in the U.S. are Superior, Wisconsin; Calumet, Illinois; and Ohio. Coal is received at a large number of ports (over 30) in Minnesota, Wisconsin, and Michigan.

- Limestone—The Great Lakes region is a large supplier of limestone, with the largest quarry in the world at Rogers City, Michigan. Limestone is shipped from a number of Michigan ports and other ports throughout the Great Lakes.

Of the Canadian ports, taconite is shipped primarily from Quebec (Port Cartier, Sept Iles, and Pointe Noire), limestone from Ontario (Port Colborne, Thessalong, Meldnum, and Bruce Mines), and coal from Thunder Bay, Ontario. Most of the coal transport is into Canada.

TABLE 1-2
Carriage on the Great Lakes: 2000–2006 Shipping Seasons (U.S.-Flag Vessels, in tons)

Commodity	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	Average 2000–2006
Taconite	60,332,678	46,924,703	48,195,327	43,016,285	51,201,511	46,572,119	48,972,112	49,316,391
Direct shipments	54,586,514	43,829,971	45,861,075	41,343,509	48,265,018	43,884,572	45,850,298	46,231,565
Transshipments[a]	5,746,164	3,094,732	2,334,252	1,672,776	2,936,493	2,687,547	3,121,814	3,084,825
Coal[b]	20,760,474	21,959,051	21,743,831	21,879,426	24,416,349	27,207,350	25,333,113	23,328,513
Limestone	27,288,089	26,988,622	26,554,243	24,239,110	29,861,141	27,935,513	29,489,410	27,479,447
Cement	4,144,774	4,136,897	3,817,911	3,851,487	3,965,401	3,892,822	4,024,703	3,976,285
Salt	838,017	876,392	587,090	945,355	1,032,109	1,187,777	1,126,862	941,943
Sand	427,070	625,094	230,950	500,456	489,355	461,813	429,411	452,021
Grain	351,857	350,719	329,471	312,316	367,785	403,055	357,143	353,192
Totals	114,142,959	101,861,478	101,458,823	94,744,435	111,333,651	107,660,449	109,732,754	105,847,793

Source: LCA, 2007.
[a]Taconite transshipments are carried within Cleveland Harbor.
[b]Coal carriage includes Lake Superior, Lake Michigan, and Lake Erie.

In general, U.S.-flag ships transported decreased quantities of dry bulk cargoes on the Great Lakes from 2000 to 2003, with an upturn in 2004. Transport quantities in 2005 and 2006 showed small downturns from 2004, but have remained above the low points observed from 2001 through 2003. From 2005 to 2006, the quantity of dry bulk cargoes transported increased by 2 percent. While coal and limestone transports were higher in 2007 than in 2000, the overall decreased transport of taconite, coal, and limestone over the 7-year period is attributed to a decline in the steel industry and dropping demand for raw materials.

1.1.4 Cargo Handling and Movement of Dry Bulk Cargos

On the Great Lakes, dry bulk cargoes typically are shipped continuously from mid-March through late December or early January depending on ice coverage. Vessels stop in port only to load and unload various cargoes. Over the past several decades, U.S. dry bulk carrier operations have become increasingly efficient with larger, more complex vessels capable of transporting a variety of cargoes and rapidly unloading as a result of self-unloading conveyor systems. The Canadian fleet possesses fewer self-unloading conveyor systems.

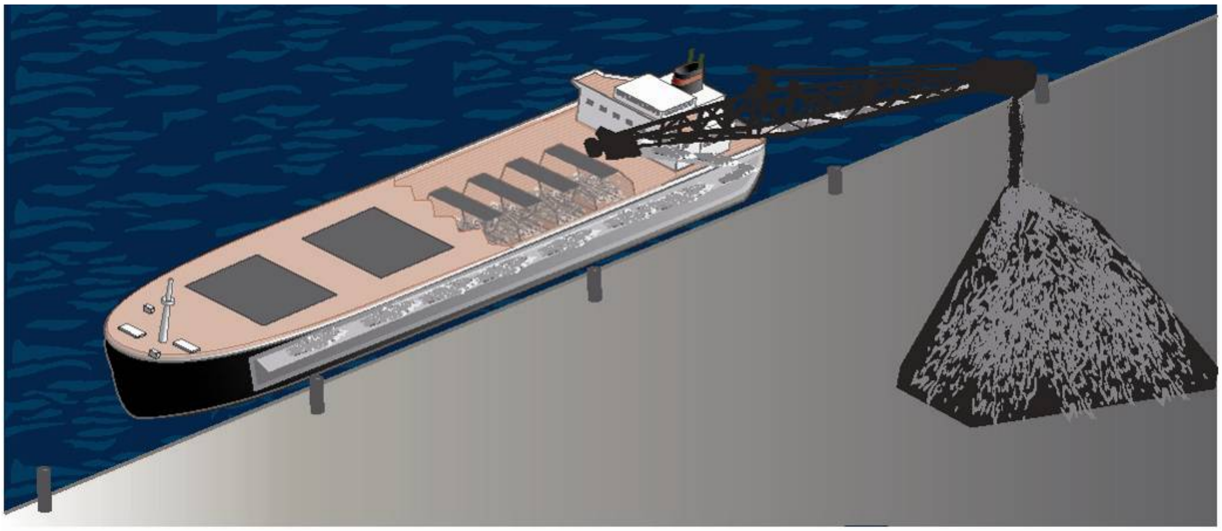
Most shoreside loading facilities have motorized conveyor belt systems that quickly transfer dry bulk cargo from shoreside storage areas to vessel holds, and the entire U.S. fleet of dry bulk carriers can load and unload with little or no shoreside assistance (USCG, 2006). Consequently, the U.S. crew sizes have decreased as loading and unloading operations have become automated, and operating schedules have tightened so that port time has been reduced to the greatest extent possible. In addition, transfer systems may be preloaded, or “charged,” before a vessel’s arrival, significantly reducing the amount of time that a vessel spends in port.

Although the pace of loading or unloading varies with the conveyor loading mechanism, the size of the ship, cargo type, and port facilities, a self-unloading vessel can be unloaded in 8 to 20 hours. When delays occur, they are typically the result of slow cargo-screening or reclaiming processes, as well as mechanical breakdowns such as broken chutes, loading belt failures, or mechanical breakdowns (USCG, 2006).

During loading, conveyor belts transport dry bulk cargo from the shore to ships. Depending on the type of conveyance system, the conveyor belt may be stationary, requiring the vessel to shift position to allow the cargo to be loaded in individual holds, or the conveyor belt may be shifted from hold to hold. During loading, a ship’s officer is always on deck and in contact with the shoreside loading operator to ensure that the proper amount of cargo is loaded and that the cargo is loaded in a sequence that minimizes hull stress and ship listing. In the event of DCR falling onto the deck, the loading officer may stop the loading process or request the loading operator to take more care to reduce DCR.

Self-unloading vessels have a conveyor belt that passes underneath the cargo holds and runs the length of the vessel holds, as shown in Figure 1-1. Gates at the bottom of each hold release cargo to the conveyor belt. Cargo flows are controlled by adjusting the gate opening and controlling the speed of the conveyor belt. In general, faster unloading leads to a higher risk of DCR in the cargo tunnel. An automated system monitors the amount of cargo being loaded on the belt, and signals the operator when the cargo load approaches or exceeds a predetermined threshold. If a threshold is approached, adjustments can be made to optimize the unloading rate and reduce residue.

FIGURE 1-1
Representation of Cargo Unloading



When the cargo reaches the end of the unloading belt, additional (incline) conveyor belt(s) transfer it upward to the deck near the after end of the ship. On deck, the cargo is transferred to the boom conveyor belt, and the boom (up to 250 feet long) is swung over the side of the vessel to deposit it into a hopper or directly onto the dock.

1.1.5 Dry Bulk Cargo Residues

During loading, this DCR may fall onto the deck of the vessel. During unloading, the residues may fall off conveyor belts in tunnels under the vessel's deck. Washdowns of deck and tunnel areas, resulting in sweeping of DCR into the Great Lakes, has been a standard practice for more than 75 years, with DCR sweepings occurring on the Great Lakes for as long as shipping has been present (USCG, 2006). DCR deposits can occur in several ways. With conveyor systems, cargo such as taconite pellets may roll or bounce off of the conveyor belt. Softer cargoes such as coal and limestone may deposit dust that is blown off the conveyor belt during loading or unloading. Cargo in holds might be wet as a result of rain, snow, or spraying for dust suppression. Wet cargoes can stick to the cargo holds and flow to the cargo hold gates in large, uneven flow rates, spilling over the side of the cargo tunnel conveyor. Wetter cargoes may stick to the conveyor belt and fall off the belt as clumps, or the water may contribute a dilute slurry of residue that drips from the conveyor belt or holds. Mechanical failures, such as broken belts or stuck gates, can also generate residues.

Other sources of DCR deposits are operator related. If a conveyor belt remains active as it moves from hold to hold, cargo may be deposited on the deck between storage holds. Even if a conveyor belt is stopped as it moves between holds, residues remaining on the belt may fall onto the deck when the conveyor belt is again moved. Washing holds, which assists cargo flow onto the unloading system and cleans the last residues from the holds at the end of unloading, can result in slurry draining into the cargo tunnel and flowing into the sump. Overfilling, or "topping off," cargo holds also may contribute to DCR in deck areas.

Mechanical failures can contribute to DCR falling onto the deck and in the ship tunnel. For example, DCR in the tunnel can occur when the unloading gate fails in an open position and the unloading conveyor is overloaded with cargo. The overloaded conveyor can contribute to tunnel and possibly deck residue as the overloaded conveyor is transferred between belts to reach the deck unloading conveyor/boom. Deck DCR can also be generated from shoreside loading operations when shoreside gates fail in an open position on the loading conveyor and the ship or shoreside loading conveyor reposition over the cargo holds.

DCR on the deck and in cargo tunnel areas is often washed with water (swept) when a vessel is underway to support general vessel cleanliness, maintain safe vessel conditions, and prevent cross-contamination with other cargoes. High-pressure fire hoses are used to wash the deck with water pumped from the Lakes, and residues are swept with washwater into the Lake. Cargo tunnels are washed similarly, with water provided by high-pressure fire hoses; the washwater is stored and then discharged by sump pump into the Lake. Washing activities on large ships may consume 4 to 6 hours (USCG, 2002). Alternatively, DCR may be manually shoveled into the holds, time and schedule permitting.

Deck and cargo tunnel areas of vessels carrying cargoes such as taconite, which are round, slippery pellets, are cleaned more frequently those carrying limestone, which pose less of a safety hazard. Washing is less likely to occur on vessels carrying the same cargo from one trip to the next. Washing also may not occur for shuttle trips between ports where a vessel does not pass out of a sweeping exclusion area (USCG, 2006; USCG, 2002).

USCG (2002) provides the most comprehensive analysis of DCR sweeping available to date (Table 1-3). During winter lay-up following the 2000–2001 shipping season, ship logs were reviewed for vessels at four U.S. ports, two Canadian ports, and two Canadian shipping headquarters. Data were compiled for roughly 50 percent of Canadian ships and 67 percent of U.S. ships on all five Lakes. DCR sweeping was estimated conservatively by doubling the reported values to account for unsurveyed ships. The weight of swept DCR was approximately 0.0006 percent of total cargo transported. Further breakdown of total sweepings into U.S. and Canadian components does not exist for recent years (USCG, 2002). As part of this analysis, the authors noted that DCR sweeping s from U.S. and Canadian vessels are lower than previously documented in a Melville (1993) shipping report that also relied on industry data, suggesting that improvements in loading and unloading operations are leading to reduced DCR sweeping s (USCG, 2002).

A follow-up study surveyed DCR losses of taconite, coal, and stone during the 2004–2005 shipping season (USCG, 2006). Table 1-4 summarizes DCR sweeping s by Lake. Data were collected from U.S. vessels docked at selected U.S. ports. There are no data included for Lake Ontario because U.S. dry bulk carriers do not operate on that water body. The USCG (2006) report compared the results against a comparable subset of USCG (2002) data (U.S. vessels carrying taconite, coal, or stone). The USCG (2006) findings were consistent with those of USCG's (2002): that cargoes other than taconite, coal, and limestone account for less than 5 percent of all DCR inputs.

DCR deposits also were examined to assess the relative contribution of deck and cargo tunnel areas to sweeping quantities (USCG, 2006). Although data were variable, inconsistently collected, and dependent on industry estimates, in most cases, indications are that deck areas were larger contributors to DCR sweeping s than cargo tunnels (Table 1-5).

TABLE 1-3
Comparison of Estimated DCR Discharge Relative to Total Transported Cargo: 2000–2001 Shipping Season
U.S. and Canadian-Flag Vessels (in Tons)

	Total	Taconite	Coal/ Coke	Stone	Cement	Salt	Grain
U.S. sweepings[a]	356	144	80	132	—[d]	—[e]	—[e]
Canadian sweepings[b]	138	41	62	11	3	10	11
Total swept[d]	494	185	142	143	3	10	11
Total transported	165.5×10^6	55.9×10^6	43.8×10^6	37.1×10^6	5.5×10^6	8.6×10^6	14.0×10^6
% swept	0.0003	0.0003	0.0003	0.0004	0.00005	0.0001	0.00007
Estimated total % swept	0.0006	0.0006	0.0006	0.0008	0.0001	0.0002	0.00014

Source: USCG, 2002.
[a]From ship logbooks for approximately 67 percent of U.S. flag vessels.
[b]From ship logbooks for approximately 50 percent of Canadian flag vessels in U.S. waters.
[c]2 × % swept to prorate for total estimate.
[d]On U.S.-flag vessels, cement is transported without residues because it is handled in a vacuum line.
[e]No U.S.-flag vessels surveyed carried salt or grain.

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TABLE 1-4
Quantity of DCR Swept into the Great Lakes: 2004-2005 Shipping Season, U.S.-Flag Vessels (in Tons)

Lake	Taconite	Coal	Limestone	Other[b]	Total
Erie	31.65	6.10	9.10	0.48	47.33
Huron	57.00	23.65	35.90	1.91	118.46
Michigan	40.10	9.65	37.70	1.96	89.41
Superior	119.00	27.90	15.35	N/A	162.25
Unattributed[b]	78.50	42.05	16.00	1.30	137.85
Total	326.25	109.35	114.05	5.64	555.29

Source: USCG, 2006.
[a]Prorated from 34 voluntary log books to estimate industry practices.
[b]Combined lesser and “unspecified” cargoes.
[c]Indicates that specific Lake which residue was sweeping into could not be determined from the logbook data.

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TABLE 1-5
Ratio of DCR Discharge Deck and Cargo Tunnel: 2004–2005 Shipping Season, U.S.-Flag Vessels (in Tons)

Lake	Taconite	Coal	Limestone	Other	Total
Erie	0.10	2.41	11.90	0.70	1.30
Michigan	0.00	7.27	0.00	NA	1.83
Superior	5.08	5.78	4.86	5.19	5.23

Note: Does not include discharge that was not categorized as originating from the deck or cargo tunnel or data that were large, accidental discharges. Lake Ontario not included because no Great Lake U.S.-flag dry bulk carriers operate on the Lake. Lake Huron data not available. Ratio of 1.0 indicates equal discharge from Deck and Tunnel. Ratio greater than 1.0 indicates more DCR swept from deck.
Source: USCG, 2006.

1.2 Purpose and Need

The purpose of the Proposed Action is to regulate nonhazardous, nontoxic DCR sweeping from vessels in the Great Lakes that fall under the jurisdiction of the United States. The regulation must comply with the Coast Guard and Maritime Transportation Act (CGMTA) of 2004, Public Law 108-293, § 623. The CGMTA of 2004 provides that, in the absence of promulgating formal regulations governing sweeping from vessels of dry bulk cargo residues in the Great Lakes, the Coast Guard's current enforcement policy will expire on September 30, 2008. As described above, in Section 1.1, the Act also grants the Commandant of the Coast Guard, notwithstanding any other law, the permanent authority to promulgate regulations governing the sweeping of dry cargo residue on the Great Lakes. This EIS fulfills the statutorily mandated requirement to conduct an "environmental assessment" in support of its proposed action.

The proposed action would fulfill the Coast Guard's need to provide regulations with clear and concise definitions and expectations. In exercising its authority under Public Law 108-293, the Coast Guard seeks to optimize the outcome for maritime safety, protection of natural resources, and maritime mobility, all of which, along with maritime security and national defense, are Coast Guard strategic goals. These objectives formed the basis for screening criteria described in Chapter 2 and were used to identify alternatives that meet the purpose and need. Alternatives that met the screening criteria are evaluated in detail in this EIS.

1.3 Public Involvement

Public involvement has taken a variety of forms and has included the scientific and regulatory communities, the shipping industry, and general public. When first established, the IEP prevented sweeping of DCR in selected "enforcement areas" (U.S. Coast Guard, 1993). The Coast Guard recognized that this general designation of exclusion areas was an initial resource protection effort and asked the National Oceanic and Atmospheric Administration (NOAA) and Great Lakes Environmental Research Laboratory (GLERL) to form an ad hoc scientific steering committee to review available information and to advise them on the environmental implications and effectiveness of the interim regulations. Part of the steering committee's action was to convene a workshop to review the IEP in general and the exclusion areas specifically (Reid and Meadows, 1999). The workshop was held in 1994 and attended by NOAA, other Great Lakes scientists, and representatives of the Great Lakes shipping industry. The committee recommended several modifications to the exclusion areas, summarized below, to achieve vulnerable ecological resource protection (Table 1-6).

TABLE 1-6
NOAA/GLERL Steering Committee's Recommended Modifications to the IEP

	Recommendation
1	Reevaluate proposed 12-mile enforcement limit to all cargoes, since most cargoes are not a threat to environment
2	There is no basis for restricting such natural materials as limestone, sand, gravel, clay, refractory materials, and gypsum, or rock salt, potash, fertilizer, cement, grain, seed, and wood pulp, except in spawning areas
3	Discharge of rock salt, potash, fertilizer, grain, seed, and wood pulp residues is to be avoided in western Lake Erie, Lake St. Clair, Saginaw Bay, and Green Bay unless absolutely impractical to do so elsewhere

TABLE 1-6
NOAA/GLERL Steering Committee's Recommended Modifications to the IEP

	Recommendation
4	Materials with toxic components (taconite, coal, coke, millscale, and slag) should be discharged at the proposed 12-mile restriction area until studies can determine actual risk to the environment. Taconite was evaluated and found to pose little acute threat to the ecosystem, and so on April 7, 1994, the Coast Guard moved the enforcement limit to 6 miles for most areas of the Lakes
5	Frequency of sweeping should be considered when contemplating changes to policy, as areas of less frequent sweeping will have lower potential for risk
6	Shippers are to aggressively seek new procedures and technologies to lessen discharged residues
7	Discharges should be continued in the areas used historically until there is a scientific basis for changing the practice. This would minimize contamination of new areas

Note: All miles are statue miles.
Source: Reid and Meadows, 1999.

LCA, an industry organization representing the interests of the commercial cargo shippers on the Great Lakes, participated in the 1994 NOAA workshop and in subsequent discussions to provide input to the definition of exclusion areas. It identified areas where relaxation of the DCR sweeping prohibition was necessary for economical transport of dry cargo on the Great Lakes. Those areas are referred to as special rules or exemptions to the exclusion areas.

The Coast Guard took the recommendations from the steering committee and the LCA under consideration when it revised the IEP in 1997. The specific recommendations for location modifications of exclusion areas, such as those made by the LCA and Recommendation 3 in Table 1-6, were incorporated into the revised IEP.

Based on the committee's recommendations, the Coast Guard initiated studies, that are referenced in this DEIS, to characterize the geographic distribution of sweepings, their chemical make-up, and potential effects on water quality and the Great Lakes biota.

The Coast Guard sought additional public input on December 27, 2004 (69 FR 77147, corrected at 70 FR 1400, January 7, 2005) when it announced that it would conduct a study of current dry cargo residue sweeping practices in the Great Lakes and requested information from the public that could help in the conduct of the study.

Public involvement also has been sought through scoping activities, described in Section 1.4, and through two expert committees convened to share knowledge and references on existing limnological conditions in the Great Lakes; review methods and results of Coast Guard-sponsored DCR- related scientific investigations in the Great Lakes; and provide input on scientific investigation methods and advice on data interpretation. The first expert committee consisted of resource experts and representatives of National Centers for Coastal Ocean Service, NOAA, and LCA. The second expert committee was convened in September 2007 to provide input on mussel investigations (Appendix B).

1.4 Scoping and the Notice of Intent

Alternatives to manage the sweeping of DCR have been considered by the Coast Guard and Congress at various times, with input requested from the public and other Federal and State agencies. This section summarizes past opportunities for the public to provide input to the management of DCR sweeping .

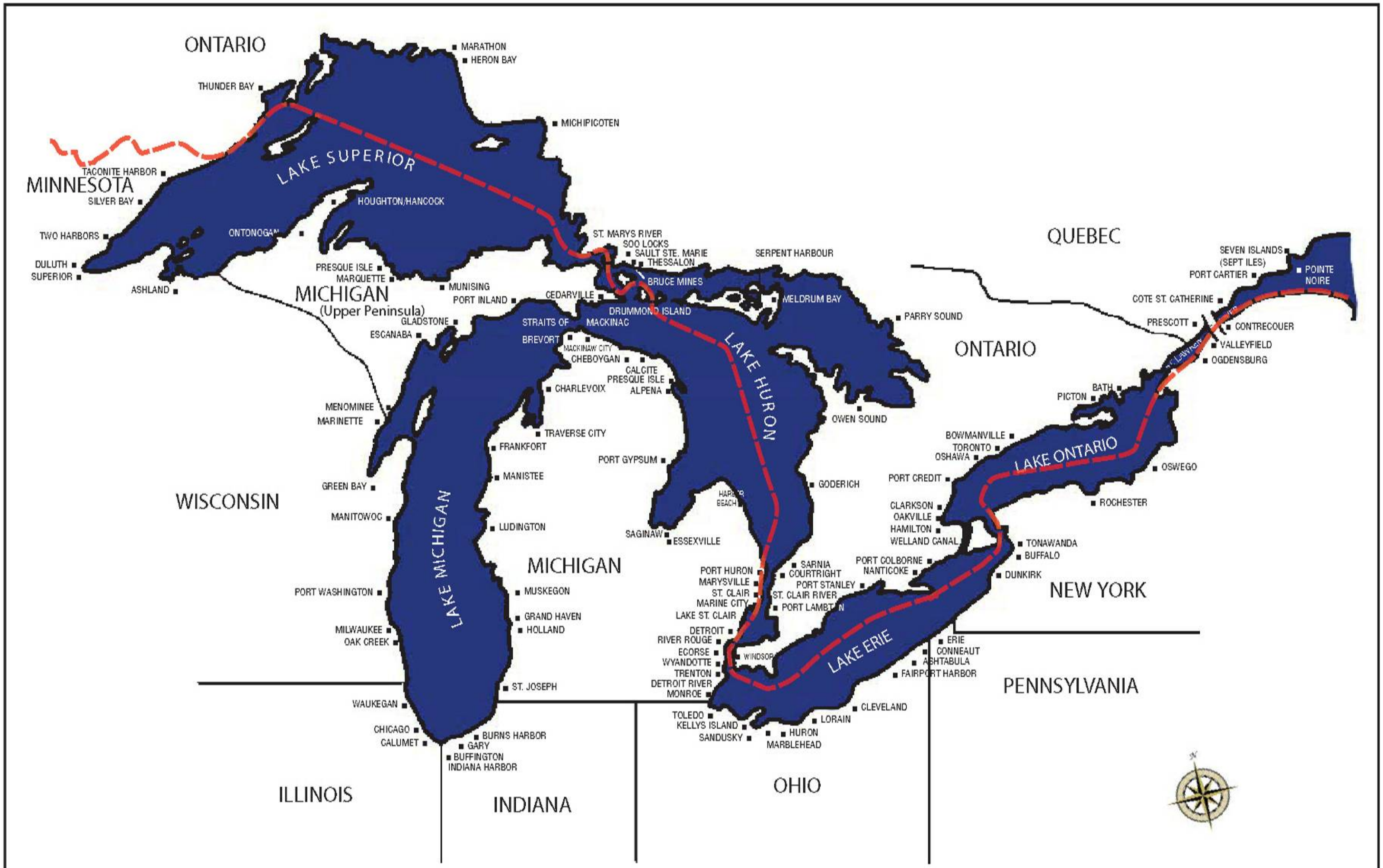
An NOI to prepare an EIS in connection with the development of new regulations on the sweeping of DCR in the Great Lakes and a Notice of Availability of a study on current DCR sweeping practices have been published. The NOI, which requested public input, was published in the *Federal Register* on March 9, 2006 (71 FR 12209). Documents pertaining to the proposed regulatory action are available in a public docket accessible at http://dms.dot.gov/search/searchFormSimple.cfm under Docket Number USCG-2004-19621.

A NEPA public scoping meeting in support of rulemaking on the regulation of the DCR sweeping in the Great Lakes was held in Cleveland, OH on July 6, 2006. A notice for the public scoping meeting and summary of comments received is provided in Appendix C. A sampling plan proposal to be conducted in whole or part was made available in the docket. As part of the NOI, the Coast Guard initially identified alternatives to be considered in the EIS, as described in Chapter 2 and Appendix D.

Following the publication of the NOI, public feedback assisted the Coast Guard in determining the scope of issues to be addressed in the EIS, identifying significant issues related to the Proposed Action, and ensuring that potentially suitable alternatives had not been overlooked. Based on public scoping input and further consideration of the Purpose and Need, the Coast Guard and its interdisciplinary team developed additional alternatives and refined those proposed in the NOI for consideration in the Draft EIS.

1.5 Scope of the Environmental Impact Statement

The study area for the Draft EIS is shown in Figure 1-2, and includes all vessels carrying dry cargo on the Great Lakes except non-self-propelled barges. In the development of the EIS, potential alternatives were identified and a reduced list of alternatives was determined to be reasonable for detailed evaluation (Chapter 2). Some potential alternatives were rejected as not meeting the Purpose and Need. Those alternatives determined to meet both Purpose and Need were developed in greater detail. An interdisciplinary team of environmental scientists, biologists, economists, engineers, and technicians analyzed the Proposed Action and alternatives in light of the affected environment (Chapter 3), and identified potential adverse and beneficial effects associated with the alternatives (Chapter 4). Chapters 3 and 4 consider all potential resource areas but provide in-depth analyses of only those areas of the natural and human environment potentially affected by the Proposed Action or any alternative. The remaining chapters address mitigation measures and compare alternatives; cumulative and other impacts; and required permits, licenses, and approvals relating to the alternatives.



Reference: *Lake Carriers' Association (LCA 2004), GoogleEarth 2007*

Canada-United States International Border

FIGURE 1-2
Project Location
U.S. Coast Guard Dry Cargo Sweepings EIS

CG032007001PHX_US CoastGuard_Project Location.ai (3/07)

CHAPTER 2

Description of Alternatives

2.1 Development of Alternatives

2.1.1 Introduction

As described in Chapter 1, alternatives to manage the sweeping of dry cargo residues were identified and considered by the Coast Guard with input from the public and other federal and state agencies. Potential alternatives were evaluated for feasibility and to determine whether alternatives meet the Purpose and Need of the Proposed Action.

In evaluating alternatives, the Coast Guard also considered whether alternatives meet the following Coast Guard strategic goals: optimizing maritime safety, protecting natural resources, and optimizing maritime mobility.

To ensure that a consistent, reproducible approach was used in evaluating alternatives, screening criteria were applied to all of the alternatives identified in the NOI, plus all other alternatives that had been developed as part of the scoping and internal Coast Guard technical review process.

Alternatives that meet the Purpose and Need will:

- Prevent impacts that significantly degrade Great Lakes aquatic resources
- Regulate with only minimal additions to existing Coast Guard organizational structure and resources
- Avoid regulating dry bulk carriers and related shoreside facilities in a way that threatens their continued economic viability
- Avoid regulating dry bulk carriers in a way that threatens their safe operation
- Minimize additional energy use
- Provide for an adequate and appropriate record keeping and compliance monitoring system
- Use proven DCR control measures

2.1.2 Alternatives Considered for Inclusion in the Draft EIS

The following eight alternatives were identified from those listed in the NOI, suggested during the public scoping process, or during further Coast Guard consideration as potential alternatives that should be assessed relative to the criteria outlined in Section 2.1.1:

- No Action—Would allow the IEP to terminate on September 30, 2008, without additional extensions. Upon termination of the IEP, existing laws and regulations effectively banning the sweeping of dry cargo residues into the Great Lakes would be enforced. Although the No Action alternative does not meet all of the criteria, as described in Appendix D, NEPA requires that it be examined for comparison to the other alternatives.

- Proposed Action—Would adopt the IEP as the basis for Coast Guard regulation with new requirements for standardized recordkeeping.
- Adopt the IEP without Significant Change—This alternative would adopt the IEP and may include minor modifications to exclusion areas where DCR sweeping is prohibited, based upon scientific findings of studies conducted in conjunction with this environmental analysis.
- Proposed Action with DCR Control Measures on Ships—This alternative would adopt the IEP and would require implementation of above- and below-deck ship DCR control measures that are structural and operational. It could involve a variety of measures, including structural modifications to conveyor systems and modified operational practices. Initially, this alternative consisted of subalternatives that differed by whether control measures were implemented at shore or while a ship was in transit. A complete list of control measures that were considered in developing this alternative is provided in Appendix E. This alternative is a variation of the alternative identified in the NOI as "Adopt the IEP as the basis for permanent regulations, possibly with significant changes."
- Proposed Action with Modified Exclusion Areas--Exclusion areas could be modified to limit sweeping of DCR in previously unidentified sensitive areas and designated protected areas. Exclusion areas also could be modified to allow sweeping in areas that are less sensitive than previously considered, or to limit sweeping of certain types of cargos.
- Proposed Action with Shoreside DCR Control Measures—Would implement the Proposed Action and regulate shoreside facilities to control or eliminate dry cargo residue on the vessel during vessel loading or unloading.
- Develop Coast Guard System of Permits—Would develop and implement a Coast Guard permit system for vessels discharging dry cargo residues. The permit system also would impose recordkeeping and reporting requirements that would enable the Coast Guard to review program impacts and effectiveness. This system would limit the sweeping volume and location of all or selected types of residues.
- Modify Deck and Tunnel Areas — Would involve modifications to the decks or tunnels of vessels to prevent the residue from going overboard, including diversion of the washwater used in dry cargo residue sweeping to prevent its overboard sweeping.

After identifying alternatives, each alternative was evaluated relative to the Purpose and Need (Appendix D). Alternatives meeting all of the criteria were retained for further evaluation in the Draft EIS. Alternatives not meeting one or more criteria were excluded from further consideration. If an alternative met some of the criteria but preliminary data were insufficient to determine whether an alternative met all of the criteria, the alternative was retained for further evaluation to assure that potentially feasible alternatives were not eliminated for lack of data.

Section 2.1.3 describes alternatives eliminated from further consideration. Sections 2.2 through 2.6 describe alternatives to be evaluated in the EIS and how each of the alternatives compares to current shipping, loading, and sweeping practices. During the alternative screening process, minor modifications were incorporated so the description of alternatives selected for detailed evaluation (as described in Sections 2.2. to 2.6) differ slightly from the description of the corresponding alternative in the eight listed above and in Appendix D.

Although alternatives evaluated in the EIS are presented as distinct alternatives, elements of different alternatives may be combined based on the results of the Chapter 4, Environmental Consequences evaluation.

2.1.3 Alternatives Eliminated from Further Consideration

Three of the alternatives did not meet one or more of the screening criteria. The reasons for considering those alternatives infeasible are summarized below and described in more detail in Appendix D. Five of the alternatives were found to be feasible and are evaluated in detail in the Draft EIS. The No Action alternative was carried forward in the Draft EIS, as required by the NEPA process.

2.1.3.1 Adopt the IEP without Significant Change

Adopting the IEP as the basis for Coast Guard regulation without significant change is inconsistent with the screening criteria, as it does not provide for adequate and appropriate recordkeeping and compliance.

2.1.3.2 Develop Coast Guard System of Permits

Under this alternative, the Coast Guard would establish a permit system, patterned on National Pollutant Discharge Elimination System (NPDES) under the Federal Water Pollution Control Act (FWPCA), as amended (CWA). Dry bulk carrier operators needing to sweeping dry cargo residue would seek a permit from the Coast Guard prior to making any sweeping of specified materials.

This alternative did not meet the criteria, and thus did not meet the Purpose and Need. This alternative would result in a major new permitting program and require a significant increase in Coast Guard staff resources to administer the permit program, review permit applications, issue permits, and monitor for compliance. Any beneficial impacts identified for this alternative were also included in other alternatives that met the criteria.

2.1.3.3 Modify Deck and Tunnel Areas

Under this alternative, deck and tunnel areas of a vessel would be modified to divert sweeping water and prevent its overboard discharge. Below-deck storage of the collected washwater could occur using ballast tanks or by pumping tunnel washwater to above deck storage tanks. However, the deck sweeping, on average, lasts for approximately 3.5 hours (USCG, 2006) and can use as much as 9,500 gallons to 106,000 gallons of water per washing (Melville, 1993). Retaining quantities of water this large on a vessel’s deck would compromise its stability and threaten the safety of crews. Therefore, this option would not meet the need for safe operation of vessels. Similarly, adding water storage troughs to the deck of a vessel does not meet the requirement of using proven DCR control measures.

Another option that was considered is modification of the cargo hold opening to allow sweeping of DCR into the hold. This modification, which would require removing the coaming, or raised frame around the hatchway in the deck of a ship, to accept DCR sweeping, could compromise the ability of the holds to keep out lake water and maintain the stability of the vessel. This alternative does not meet criteria related to safe operation of vessels and use of proven DCR control measures.

2.2 Alternative 1—No Action

NEPA regulations require the analysis of a No Action alternative. The No Action alternative establishes a baseline from which to compare other alternatives, including the Proposed Action. Under the No Action alternative, the Coast Guard would not promulgate new regulations, and the IEP would remain in effect until its September 2008 expiration. After that date, existing laws and regulations effectively banning all DCR sweeping would be enforced. (See Chapter 1 for discussion of other laws and regulations.)

Internationally, the discharge of garbage and operational wastes generated during normal ship operation is regulated under Annex V of MARPOL 73/78. Implementing guidelines adopted at the International Maritime Organization (IMO) for Annex V clarify that operational waste includes cargo residues. In addition, when Congress adopted APPS amendments, 33 U.S.C. §§ 1901–1915, to implement Annex V, it applied the MARPOL 73/78 rules to internal waters. The statute, 33 U.S.C. § 1901(b), provides that "the requirements of Annex V shall apply to the navigable waters of the United States, as well as to all other waters and vessels over which the United States has jurisdiction." Section 1902(a) applies the discharge requirements to U.S.-flagged ships "wherever located" and to foreign flagged vessels "while in the navigable waters or the exclusive economic zone of the United States." The result of extending the MARPOL 73/78 Annex V discharge rules to U.S. internal waters is a prohibition of all garbage discharges in those waters.

Similarly, under CWA Sections 301, 302, and 402 which address discharges to waters of the United States, and Section 404, which regulates the discharge of solids to surface waters, permits are unlikely to be issued by each state for sweeping of DCR.

As a result, the DCR now being swept to the Great Lakes would not be allowed. If dry cargo transport via Great Lakes shipping continued, the DCR would be washed from a ship's tunnel, swept from its deck, and collected. For the purposes of impact analysis under the No Action alternative, the collected DCR from tunnels would be transported by pump system to shoreside facilities where it would be pretreated to remove a significant amount of solids for disposal prior to discharging the pretreated washwater to the municipal sewer. The deck sweepings would be transported dry to either the cargo hold (during loading) or shoreside to the product storage area (during unloading). The costs associated with the No Action alternative, which are described in more detail in Appendix F, include the following:

- Shoreside pretreatment facility
- Sewer use charge imposed by the municipal sewer
- Ship modifications to interior piping and pumping to allow DCR washwater to be carried to a shoreside treatment facility

- Delays associated with sweeping or washing DCR

The costs associated with the proper treatment of wastewater (detailed in Appendix F) would be substantial, and therefore not meet the screening criteria with respect to preserving the economic viability of carriers. Costs of this magnitude could impede the economic viability of carriers. It is, however, carried forward as required by NEPA.

2.3 Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)—Coast Guard Preferred Alternative

The Proposed Action would adopt the IEP for the Great Lakes as a Coast Guard regulation with new requirements for standardized recordkeeping by vessels that sweep DCR. Recordkeeping would be mandatory, in keeping with standard practice for effective environmental management programs. Dry bulk cargo transport would continue to follow current patterns and practices. The Proposed Action would continue current dry cargo loading and unloading practices, as described previously, and allow for the continued “cargo sweeping” practices in areas not designated as “enforcement” or exclusion areas in the 1997 revisions to the IEP. In a continuation of current practices, DCR deposited on a ship's deck or in tunnel areas during loading or unloading would be washed from the ship's deck or tunnel directly or indirectly into the Lake.

2.3.1 IEP Adoption

The IEP for the Great Lakes would be adopted as a Coast Guard regulation, and provide the basis for continuing the sweeping of DCR. The regulation would continue to apply to U.S. vessels anywhere in the Great Lakes and vessels of any nation operating in the U.S. waters of the Great Lakes.

In general, sweeping is excluded from areas based on distance from shore, water depth, and proximity to or collocation with designated special protection areas, as defined in the IEP. Exclusion areas and exemptions are summarized below. Section 2.4 describes the current exclusion areas. Note that unless designated otherwise, all miles given in this EIS are statute, or land, miles, not nautical miles.

Sweeping of the “cleanest” materials (such as limestone) would continue to be allowed closer to nearshore areas. Sweeping of materials with the potential to affect water quality or biota (such as coal and salt) would be excluded from nearshore areas and allowed to be swept outside of spawning and nursery areas. This reduces their potential to affect fish resources at sensitive life stages (Reid and Meadows, 1999). Sweeping of cargos prohibited from discharge by other regulations would not be allowed.

In a continuation of current practices, generally, sweeping would be allowed as follows:

- Limestone and clean stone sweeping : allowed without restriction
- Taconite sweeping : generally allowed beyond 6 miles from shore, with a greater exclusion area established for shallow water shoals and islands in Lake Superior

- Coal and salt sweeping : allowed beyond 13.8 miles from shore
- Cement sweeping : allowed beyond 13.8 miles from shore
- Other nonhazardous material sweeping : allowed beyond 13.8 miles from shore

Modifications to areas where sweeping is allowed and excluded would continue to fall into the two categories identified in the IEP (U.S. Coast Guard, 1997):

- Special Protection Areas, established to protect sensitive ecological resources, such as fishery spawning and nursery grounds, and drinking water supply intakes, would be excluded from sweeping activities.
- Special rules, or exemptions to exclusion areas, would continue to allow sweeping where it is necessary for economical transport of dry cargo.

These areas are detailed in Section 2.4, which summarizes current exemptions to exclusion areas.

2.3.2 Standardized Recordkeeping

Recordkeeping and associated monitoring provide a reminder of required protocols, documentation of compliance with regulations, and a tool to evaluate inadequacies in environmental management programs. Improved recordkeeping would provide comprehensive and consistent data and provide a basis for future decision making and management of DCR. In developing the recordkeeping component of the Proposed Action, the following Coast Guard programs were reviewed as models that could provide a basis for standardizing and formalizing the voluntary recordkeeping program that occurs now.

- Prevention of Pollution by Oil—Annex I to International Convention for the Prevention of Pollution from Ships
- Prevention of Pollution by Garbage—Annex V to International Convention for the Prevention of Pollution from Ships

Each program includes recordkeeping, log certification, training, and inspection requirements, with enforcement provisions if the requirements were not met. Under the Proposed Action, a standardized recordkeeping program would be implemented. It could contain the following components:

- Recordkeeping for loading, unloading, and all DCR sweeping
- Recordkeeping for all sweeping in U.S. waters and for all U.S. flag ships
- Use of a standardized form(s)
- Required information to include the following:
  - Date, time, duration of sweeping
  - Location of sweeping by distance from shore, coordinates, or other method with notation of position relative to exclusion areas
  - Type of DCR swept
  - Source of discharge; for example, deck or tunnel (via sump pump)

  - Quantity of sweeping
  - Related information such as type of control measures in place
- Inspection in conjunction with regularly scheduled inspections or at other times the Coast Guard may be on board the vessel
- Sliding scale of penalties
- Training on recordkeeping and DCR sweeping quantity determinations

2.4 Alternative 3—Proposed Action with Modified Exclusion Areas

This alternative consists of the Proposed Action (IEP as Coast Guard regulation and recordkeeping) plus modification of the existing exclusion areas. As described in Chapter 1, exclusion areas and exemptions from exclusion areas were developed and modified over time by the Coast Guard based on experience and input from a variety of groups such as the NOAA/GLERL and the Lake Carriers' Association. Table 2-1 summarizes exclusion areas and exemptions as defined in the IEP (U.S. Coast Guard, 1997) and recommended modifications.

2.4.1 Exclusion Area Modification Methodology

This alternative consists of modifying exclusion and exclusion exemption areas. It refines the current IEP rather than restructuring the exclusion area concept or totally revising areas where DCR sweeping is prohibited. The alternative builds on the Coast Guard's recognition that the original designation of exclusion areas was an initial resource protection effort and that further modifications could be warranted in light of changing environmental or economic data. This approach to developing the alternative was selected because the exclusion areas and exemptions were identified as part of an extensive review process with input from federal and state agencies, environmental experts, and lake carriers, and then modified over the years to reflect additional concerns and inconsistencies.

The modifications proposed under this alternative are limited to the following:

- Resolve inconsistencies in the application of general exclusion area requirements among the Lakes
- Make consistent with the intent of the IEP (that is, balance ecological protection against continued economic feasibility of Great Lakes shipping), protect sensitive areas and areas where sensitive habitat types, such as fishery spawning and nursery grounds, are not adequately protected.

Based on the continued operation of lake carriers under the IEP, no need for additional exemptions to the exclusion areas were identified to ensure economic shipping of dry cargo.

TABLE 2-1
Modifications to IEP Exclusion Areas—Alternative 3 (Proposed Action with Modified Exclusion Areas)

Lake	NOAA Navigation Chart Heading from Indicated Port	Location	Existing Exclusion Areas	Existing Exemptions	Depth (Fathoms)*	Purpose	Proposed Modification
Superior	088˚, 270˚, 080˚, 279˚, 068˚, 258˚, 063˚, 248.25˚	Northwest shore between Duluth and Grand Marais	No iron ore sweeping within 6 miles, No Coal or Salt sweeping within 13.8 miles	sweeping of iron ore and coal allowed 3 miles off NW shore between Duluth and Grand Marais	17–150	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Superior	068˚, 258˚, 063˚, 248.25˚, 243.25˚, 45.25˚	Western shore, west of a line due north from Bark Point	No cement sweeping within 13.8 miles	sweeping allowed 3 miles off shore west of a line due north from Bark Point	17–109	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Superior	Unspecified on NOAA navigation charts	Caribou Island and Southwest Bank Protection Area	47˚ 30.0'N 85˚ 50.0'W 47˚ 24.2'N 85˚ 38.5'W 47˚ 04.0'N 85˚49.0'W 47˚ 05.7'N 85˚ 59.0'W 47˚ 18.1'N 86˚ 05.0'W	No sweeping in special protection area: Caribou Island and Southwest Bank Protection Area	0–73	Protect sensitive ecological resources.	No modification
Superior	Unspecified on NOAA navigation charts	Stannard Rock Protection Area	6 mile radius from Stannard Rock Light	No sweeping in special protection area: Stannard Rock Protection Area	0–130	Protect sensitive ecological resources	No modification: Add specific coordinates and leave as is.
Superior	Unspecified on NOAA navigation charts	Superior Shoal Protection Area	6 mile radius from the center of Superior Shoal, at 48˚03.2'N 87˚06.3'W	No sweeping in special protection area: Superior Shoal Protection Area	0–105	Protect sensitive ecological resources.	No modification: Add specific coordinates and leave as is.
Superior		Isle Royale National Park	Only limestone and clean stone sweeping within 6 miles of shore.	—	0-130	Protect sensitive ecological resources.	No sweeping in National Park boundaries, which extend 4.5 miles from Isle Royale and the outer islands.
Michigan	017.25˚, 015.25˚, 012.75˚, 009.25˚, 029˚, 013.5˚	Big Sable Point and Point Betsie	No iron ore sweeping within 12 miles of shore when north of 45˚N and within 6 miles when south of 45˚N	Sweeping allowed at 4.75 miles off Big Sable Point and Point Betsie along established LCA track lines	Approx. 50	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.

TABLE 2-1
Modifications to IEP Exclusion Areas—Alternative 3 (Proposed Action with Modified Exclusion Areas)

Lake	NOAA Navigation Chart Heading from Indicated Port	Location	Existing Exclusion Areas	Existing Exemptions	Depth (Fathoms)*	Purpose	Proposed Modification
Michigan	056.25˚	Poverty Island to Port Inland Light	No iron ore sweeping within 12 miles of shore when north of 45˚N and within 6 miles when south of 45˚N	Sweeping allowed along 056.25˚ LCA track line between point due east of Poverty Island to a point due south of Port Inland Light	20–56	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Michigan	013.5˚, 022.5˚	45˚N to Boulder Reef	No coal sweeping within 13.8 miles of shore.	Coal sweeping allowed along 013.5˚ LCA track line between 45˚N and Boulder Reef and along 022.5˚ LCA track line running 23.25 miles between Boulder Reef and charted position of Red Buoy #2	8–87	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit...	Prohibit sweeping near reef at north end of track line (near buoy in shallow water) at depths less than 12 fathoms to protect sensitive ecological resources. Add specific coordinates
Michigan	037˚	Between 45˚20'N and 45˚42'N	No coal sweeping within 13.8 miles of shore.	Coal sweeping allowed along 037˚ LCA track line between 45˚20'N and 45˚42'N	16–43	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Michigan	056.25˚	Between Poverty Island and Port Inland Light	No coal sweeping within 13.8 miles of shore.	Coal sweeping allowed along 056.25˚ LCA track line between point due east of Poverty Island to a point due south of Port Inland Light	20–56	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Michigan	015.25˚, 195˚, 4.75 St M, 183˚, 017.25˚, 015.25˚, 012.75˚, 009.25˚, 029˚, 013.5˚	Between Manistee and Ludington	No coal sweeping within 13.8 miles of shore.	Coal sweeping allowed within 3 miles of shore carried between Manistee and Ludington along customary routes	13–98	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit.	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is.
Michigan	Unspecified on NOAA navigation charts	Green Bay	No sweeping other than limestone and clean stone	—	0–18	Protect sensitive ecological resources.	Limestone may be swept only for voyages occurring exclusively within Green Bay

TABLE 2-1
Modifications to IEP Exclusion Areas—Alternative 3 (Proposed Action with Modified Exclusion Areas)

Lake	NOAA Navigation Chart Heading from Indicated Port	Location	Existing Exclusion Areas	Existing Exemptions	Depth (Fathoms)*	Purpose	Proposed Modification
Michigan	Unspecified on NOAA navigation charts	Milwaukee Mid-Lake Protection Area	43˚ 27.0'N 87˚ 14.0'W 43˚ 21.2'N 87˚ 02.3'W 43˚ 03.3'N 87˚ 04.8'W 42˚ 57.5'N 87˚ 21.0'W 43˚ 16.0'N 87˚ 39.8'W	No sweeping in special protection area: Milwaukee Mid-Lake Protection Area	22–69	Protect sensitive ecological resources.	No modification
Michigan	Unspecified on NOAA navigation charts	Northern Refuge, shallow reefs near Beaver Island	Only limestone and clean stone sweeping within 13.8 miles.	—	0-77	Protect sensitive ecological resources.	Prohibit limestone and clean stone sweeping of any material in the refuge and add specific coordinates
Michigan	Unspecified on NOAA navigation charts	Waukegan Protection Area	42˚ 24.3'N 87˚ 29.3'W 42˚ 13.0'N 87˚ 25.1'W 42˚ 12.2'N 87˚ 29.1'W 42˚ 18.1'N 87˚ 33.1'W 42˚ 24.1'N 87˚ 32.0'W	No sweeping in special protection area: Waukegan Protection Area	25–50	Protect sensitive ecological resources	No modification
Huron	353˚ , 247˚	Lakeport to Harbor Beach	No iron ore sweeping within 6 miles of shore: no coal or salt sweeping within 13.8 miles of shore	Sweeping allowed for vessels carrying iron ore, coal or salt upbound along Michigan thumb: No sweeping three miles from shore between 5.8 miles northeast of entrance buoys 11 and 12 to the track line turn abeam of Harbor Beach	10–17	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit	Prohibit at depths less than 12 fathoms to protect sensitive ecological resources. Add specific coordinates
Huron	353˚, 247˚	Harbor Beach to Pte. aux Barques Light	No iron ore sweeping within 6 miles of shore: no coal or salt sweeping within 13.8 miles of shore	Sweeping allowed for vessels carrying iron ore, coal or salt bound for Saginaw Bay upbound along Michigan thumb as long as sweeping is more than, 4 miles from shore and in greater than 10 fathoms of depth	16–19	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit	No modification: Water depth greater than 12 fathoms will have little impact on sensitive ecological resources. Add specific coordinates and leave as is

TABLE 2-1
Modifications to IEP Exclusion Areas—Alternative 3 (Proposed Action with Modified Exclusion Areas)

Lake	NOAA Navigation Chart Heading from Indicated Port	Location	Existing Exclusion Areas	Existing Exemptions	Depth (Fathoms)*	Purpose	Proposed Modification
Huron	137, 138˚, 318˚, 117˚, 295˚, 100˚, 230˚, 325˚, 341˚, 189˚, 225˚, 251˚, 098˚	Alpena to ports along Michigan shore south of Forty Mile Point	No coal sweeping within 13.8 miles of shore	Sweeping allowed for vessels carrying coal upbound from Alpena to ports along Michigan shore south of Forty Mile Point: as long as sweeping is more than, 4 miles from shore and in greater than 10 fathoms of depth	10–66	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit	Prohibit sweeping at depths less than 12 fathoms and add specific coordinates
Huron	Unspecified on NOAA navigation charts	Saginaw Bay	—	No sweeping of any material	0–20	Protect sensitive ecological resources	No modification: Add specific coordinates and leave as is
Huron	Unspecified on NOAA navigation charts	Six Fathom Scarp Mid-Lake Protection Area	44˚ 55'N 82˚ 33'W 44˚ 47'N 82˚ 18'W 44˚ 39'N 82˚ 13'W 44˚ 27'N 82˚ 13'W 44˚ 27'N 82˚ 20'W 44˚ 17'N 82˚ 25'W 44˚ 17'N 82˚ 30'W 44˚ 28'N 82˚ 40'W 44˚ 51'N 82˚ 44'W 44˚ 53'N 82˚ 44'W 44˚ 54'N 82˚ 40'W	No sweeping of any material	8–90	Protect sensitive ecological resources	No modification
Huron	Unspecified on NOAA navigation charts	Thunder Bay National Marine Sanctuary	No sweeping other than limestone and clean stone within 3.8 miles of shore.	—	0-55	Protect sensitive cultural resources	Prohibit all sweeping within the boundaries of the National Marine Sanctuary

TABLE 2-1
Modifications to IEP Exclusion Areas—Alternative 3 (Proposed Action with Modified Exclusion Areas)

Lake	NOAA Navigation Chart Heading from Indicated Port	Location	Existing Exclusion Areas	Existing Exemptions	Depth (Fathoms)*	Purpose	Proposed Modification
Erie	Unspecified on NOAA navigation charts	Western Basin from Toledo Harbor Light to Detroit River Light	No iron ore sweeping within 6 miles of shore; no coal or salt sweeping within 13.8 miles of shore.	Vessels in Western Basin needing to sweep iron ore, coal, or salt after unloading in Toledo or Detroit and immediately thereafter loading new cargo in Toledo, Detroit or Windsor: may sweep iron ore, coal or salt residue over the dredged navigation channels running between Toledo Harbor Light and Detroit River Light	1	To avoid unnecessary economic and energy use impacts by requiring deviation from normal transit	Limestone may be swept only for voyages occurring exclusively within the Western Basin
Erie	Unspecified on NOAA navigation charts	Detroit River National Wildlife Refuge	All sweeping s other than limestone and clean stone prohibited	Limestone sweeping allowed	0-4	Protect sensitive ecological resources	Prohibit limestone and clean stone sweeping of any material in the refuge and add specific coordinates
Ontario	—	—	—	None	—	—	—

Note: All miles are statue miles unless noted otherwise.
Source: U.S. Coast Guard,1997.
*1 fathom equals 6 feet, or 1.8288 m.

Modifications to exclusion areas were identified using the following approach:

- Review the IEP to identify general exclusions by cargo type for each Lake
- Identify and resolve inconsistencies in application of general exclusions among Lakes
- Review the IEP to identify specific exemptions by cargo type for each Lake
- Identify and resolve inconsistencies, incomplete documentation, or unintended results for specific exemptions
- Identify designated protection areas such as National Wildlife Refuges, National Marine Sanctuaries, and National Parks
- Identify representative ecological resources susceptible to impairment by sweeping of DCR
- Identify conflicts between IEP exclusion areas and exemptions, and impairment of sensitive ecological resources and designated protection areas
- Resolve ecological resources conflicts, consistent with the intent of the IEP

2.4.2 Identification and Resolution of Exclusion Area Inconsistencies

Table 2-2 lists the general exclusion areas by Lake. The inconsistencies are noted in the table, and the inconsistency resolutions are discussed below.

TABLE 2-2
General Discharge Prohibitions for Dry Cargo Shipped in the Great Lakes

Material	Lake				
	Huron	Ontario	Michigan	Erie	Superior
Limestone/clean stone	No distance	No distance	No distance	No distance	No distance
Taconite	6 miles	6 miles	12 miles[a]	6 miles	6 miles
Coal/salt	13.8 miles	No rule[a]	13.8 miles	13.8 miles	13.8 miles
Cement	No rule	No rule	No rule	No rule	13.8 miles[a]
Other nonhazardous	13.8 miles	13.8 miles	13.8 miles	13.8 miles	13.8 miles

Note: Distances are statute miles from shore, where sweeping of DCR is prohibited.
Source: U.S. Coast Guard (1997).
[a]Inconsistency.

2.4.2.1 Exclusion Area Inconsistency Modification 1

The taconite discharge exclusion areas extend 6 miles for most Lakes but 12 miles for Lake Michigan. This inconsistency is attributable to an abundance of shallow water shoals and islands in the north end of Lake Michigan. Therefore, the exclusion area limit would be maintained. Also, the IEP specifies all distances in statute miles, but the taconite exclusion appears to be in nautical miles (13.8 statute miles equals 12 nautical miles). Distance would be standardized under this alternative by changing the Lake Michigan exclusion area for taconite to 13.8 miles.

2.4.2.2 Exclusion Area Inconsistency Modification 2

Lake Ontario is the only Lake with no rule regarding coal or salt sweeping. To protect ecological resources in a manner consistent with that for the other Lakes, an exclusion area would be established under this alternative to limit coal and salt sweeping on Lake Ontario within 13.8 miles of shore.

2.4.2.3 Exclusion Area Inconsistency Modification 3

Lake Superior is the only Lake that has cement sweeping regulations. To protect ecological resources in a manner consistent with that for the other Lakes, this modification would establish the exclusion area for cement sweeping for the other Great Lakes at 13.8 miles.

2.4.3 Modification of Exclusion Areas Based on Sensitive Ecological Resources and Designated Protection Areas

Fish spawning and nursery habitats are ecological resources potentially sensitive to DCR sweeping and representative of the ecological health of the Lakes. They provide habitat needed to support fish reproduction and habitat for other aquatic organisms that are food sources for fish. By protecting their nursery habitat, the habitats of their food sources, including plants and invertebrates, are protected. Similarly, fish spawning habitat generally represents sensitive environments of limited distribution. By protecting spawning habitat, other aquatic resources in sensitive areas are protected.

As described in the next chapter, historic spawning and nursery habitat for 11 representative species was taken from Goodyear et al. (1982) to determine depth requirements, substrate preferences, and known geographical presence throughout each of the Great Lakes. The representative species are those with spawning and nursery habitat found along the shorelines or in deeper waters of the Great Lakes, and include species of particular value to commercial or sport fisheries, species that are an important component of the ecosystem (for example, an important forage food) in one or more of the Great Lakes, threatened or endangered species, or species of special concern such as the lake sturgeon. Representative species are shown in Chapter 3, in Table 3-15. Species that use shoreline areas and deeper waters as spawning and nursery areas are more susceptible to DCR sweepings than those which use riverine habitats.

Species habitat information was used in conjunction with NOAA navigation charts and the most current IEP (U.S. Coast Guard, 1997) to determine where DCR sweeping might overlap and affect required habitats of representative species. Potential sweeping areas that could affect crucial habitat of representative species were determined by identifying individual track lines, and shipping routes across the Lakes that may not be otherwise designated by track lines. Similarly, designated protection areas, such as National Wildlife Refuges, National Marine Sanctuaries and National Parks were identified to determine where DCR sweepings might affect protected resources. Modifications to exclusion areas due to sensitive and protected areas are summarized in Table 2-1. Port locations throughout the Great Lakes served as a reference for shipping routes without tracking lines (USCG, 2006).

Several exemptions to exclusion areas encompass critical habitat for sensitive ecological resources. Examination of the exclusion areas on the basis of sensitive ecological resources identified the need to extend the limit for limestone and clean stone to 3 miles. Although these DCRs generally are chemically benign, the concern regarding the current practice is that sweeping over softer substrates in spawning or nursery areas in ports or otherwise close to shore could alter the species composition of benthic invertebrates. This, in turn, could be detrimental to fish dependent on the invertebrates for food. The rationale for this modification is threefold: protection of nearshore benthic and spawning habitats; greater consistency with limitations for other cargo types; and implementation of a distance-based rather than depth-based limitation for ease of administration and consistency with other exclusions.

2.4.4 Identification and Resolution of Exemptions Inconsistent with the Intent of the IEP

Current exemptions to exclusion areas (summarized in Table 2-1) were reviewed to assess exemptions that might be inconsistent with the intent of the IEP and proposed changes were identified. Exemptions in waters greater than 72 feet deep (12 fathoms) were determined to avoid impairment of sensitive ecological resources. For example, exemptions such as those in Lake Superior between Duluth and Grand Marais, where depths drop quickly just 3 miles from shore, are not likely to cause impairment by sweeping of DCR because little spawning or nursery habitat exists there. Consequently, this alternative does not include modifications to exemptions in waters deeper than 72 feet. Other exemptions are needed to maintain shipping on the Great Lakes consistent with the intent of the IEP. Those exemptions, indicated in Table 2-1, were retained for this alternative. Also, because some exemptions allowed sweeping of DCR in sensitive areas or designated protection areas, such exemptions were modified (Table 2-1) under this alternative to prohibit sweeping s in sensitive areas or designated protection areas.

The alternative includes specific exemption coordinates for logistical and enforcement concerns. For example, on Lake Huron, sweeping is allowed for vessels carrying taconite, coal, or salt for sections of track lines near Harbor Beach at distances closer than the general rule "between 5.8 miles northeast of entrance buoys 11 and 12, to the track line turn abeam of Harbor Beach." Similarly, on Lake Michigan, sweeping is allowed at 4.75 miles off Big Sable Point, rather than 12 miles as established by the IEP. Adding this component to the definition of exemption areas would define the start and end points of allowable sweeping, thereby removing ambiguity and improving compliance and enforcement.

The alternative also would require the Coast Guard to identify the reason for allowing any exemption to an exclusion area. Some exceptions allow DCR sweeping in fish spawning and nursery habitat area; others occur for reasons not explicitly stated. The modification would clarify and support the need for sweeping in those areas, and make those reasons known to stakeholders.

2.4.5 Summary of Exclusion Area Modifications and Costs

- Lake Michigan taconite exclusion area extended from 12 miles to 13.8
- Limit of 13.8 miles from shore imposed on coal and salt sweeping in Lake Ontario
- Limit of 13.8 miles from shore imposed on cement sweeping in Lakes Huron, Ontario, Michigan, and Erie

- Limit of 3 miles from shore imposed on limestone and clean stone swept in all the Lakes
- Modification of the exclusion areas and exemptions indicated in Table 2-1
- Addition of specific unambiguous coordinates for all exemptions
- Explanation for imposition of all exemptions

With the exception of the 3-mile limit from shore imposed for sweeping of limestone and clean stone, all of the modifications included in this alternative are cost neutral. The total cost in time delays associated with the 3-mile limit would be a maximum of $7,500 per ship per year, or $412,500 per year total, based on estimates that each U.S. ship would carry limestone or clean stone 14 trips per year (USCG, 2006), would sweep only 75 percent of those trips and require a detour, and that ships would be detoured a maximum of 2.5 statute miles per trip. Additional detail is provided in Appendix F. This is a worst-case estimate that assumes that when ships carry limestone or clean stone they are within 3 miles of shore at all times. In fact, the ships carrying stone are frequently more than 3 miles from shore and thus there would be no additional costs for these ships.

2.5 Alternative 4—Proposed Action with DCR Control Measures on Ships

2.5.1 Introduction

Under the Proposed Action with DCR Control Measures on Ships alternative, the Coast Guard would adopt the IEP, require recordkeeping, and restrict the amount of DCR swept from ships by requiring ships transporting dry cargo on the Great Lakes to implement DCR control measures. Control measures function by preventing or capturing DCR to eliminate the need for sweeping. The first priority for a control measure is to prevent DCR from occurring. However, if DCR has fallen onto the ship, control measures can be used to capture the DCR and minimize sweeping.

During the alternative screening phase, this alternative consisted of the two subalternatives summarized in Appendix D: implementing control measures to reduce DCR accumulations while the ships are at port and implementing control measures to reduce DCR accumulations while the ships are in transit. After further development, differentiation between reducing DCR while at port or in transit was found unnecessary. In many cases, control measures to reduce DCR apply to both situations. Therefore, port and in-transit control measures to reduce DCR sweeping from ships are combined under a single alternative.

For purposes of defining this alternative, a master list of known DCR control measures was developed by determining measures already in place, conducting an engineering evaluation, and reviewing similar pollution control programs such as stormwater control measures. All DCR control measures were evaluated in a two-step process to determine the applicability, efficiency, effectiveness, safety, and economic feasibility of the measures to reduce ship DCR. If a control measure met all the criteria, it was considered for inclusion in the alternative and evaluated further for relative effectiveness and compatibility. Those that achieved little or no reduction in sweeping of DCR or were not compatible with other, more- effective control measures were not selected for the alternative. Control measures not excluded after the second phase of evaluation were incorporated into this alternative as summarized below. The criteria characterize the ability of DCR control measures to:

(Step 1, Screening Criteria:)

- Regulate within existing Coast Guard structure and resources
- Regulate without requiring additional time in port
- Regulate without threatening shipping safety
- Avoid energy use resulting in little or no reduction in DCR sweeping
- Use proven technology

(Step 2, Evaluative Criteria:)

- Effectively minimize DCR sweeping
- Operate without specialized equipment or training
- Function in adverse weather conditions
- Apply to most particle sizes and cargos types
- Operate without additional shoreside support
- Be used at port and in transit

Appendix E summarizes the DCR control measures, evaluation criteria, and methodology.

Control measures designed to reduce DCR can be either structural or operational. Structural control measures are mechanical devices or other physical controls that directly prevent or capture DCR on the ship deck or in the ship tunnel. An example of a structural control measure is side skirts along a conveyor belt that prevent overfilled conveyor belts from spilling cargo.

Operational control measures include methods, procedures, or other nonstructural means to reduce DCR, such as limiting the fill heights of cargo holds to below the deck elevation. Operational measures do not necessarily require retrofitting to implement. For example, limiting the fill height of the cargo holds to below the deck elevation does not require modifications to a ship; it is a procedural component of the ship's operation. Given the variability associated with loading and unloading operations on each ship, consideration of structural and operational control measures is necessary for managing DCR that would result in sweeping into waters of the United States.

2.5.2 Description of the Proposed Action with DCR Control Measures on Ships

Control measures meeting the screening and evaluative criteria were included in this alternative. The full evaluation process for all control measures is presented in Appendix E. The evaluation process for those control measures to be included in the alternative, all of which were practiced in all or some lake carriers and have a proven history of DCR control, is summarized in Table 2-3.

TABLE 2-3

Selected Structural and Operational DCR Control Measures Selected to Reduce Ship-Generated DCR

		Ship-Implemented Control Measures		Alternative Screening Criteria						Additional Evaluative Criteria					
Measure	**Description**	**Tunnel DCR**	**Deck DCR**	**Regulate within Existing Coast Guard Structure and Resources**	**Regulate without Threatening Shipping Economic Viability**	**Regulate without Threatening Shipping Safety**	**Avoid Energy Use Resulting in Little or No Reduction in DCR**	**Uses Proven Technology**	**Effectively Minimize DCR (High, Medium, Low)**	**Operate without Specialized Equipment or Training**	**Function in Adverse Weather**	**Apply to Most Particle Sizes and Cargo Types**	**Operate without Additional Shoreside Support**	**Use at Port and in Transit**	**Prevention (P) or Capture (C)**
Structural															
Enclosed conveyor	Covers installed on the loading or unloading conveyors to prevent DCR	—	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Conveyor skirts	Skirts installed at gate openings, along the length of conveyor belts, or at the bottom of cargo holds to reduce DCR from falling over the side of the conveyor	X	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Belt scrapers	Metal or synthetic scrapers that rub against the conveyor belts to dislodge cargo that may be stuck on the conveyor belt.	X	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Broom and shovel	Collect fallen material using brooms and/or shovels.	X	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Both	C
Troughed (U-shaped) conveyor belts	Conveyor belts that are U shaped to minimize DCR from the sides	X	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P

TABLE 2-3

Selected Structural and Operational DCR Control Measures Selected to Reduce Ship-Generated DCR

		Ship-Implemented Control Measures		Alternative Screening Criteria						Additional Evaluative Criteria					
Measure	**Description**	**Tunnel DCR**	**Deck DCR**	**Regulate within Existing Coast Guard Structure and Resources**	**Regulate without Threatening Shipping Economic Viability**	**Regulate without Threatening Shipping Safety**	**Avoid Energy Use Resulting in Little or No Reduction in DCR**	**Uses Proven Technology**	**Effectively Minimize DCR (High, Medium, Low)**	**Operate without Specialized Equipment or Training**	**Function in Adverse Weather**	**Apply to Most Particle Sizes and Cargo Types**	**Operate without Additional Shoreside Support**	**Use at Port and in Transit**	**Prevention (P) or Capture (C)**
Deck tarps	Tarp placed on deck in small areas of high spillage during loading or unloading to facilitate post-operation clean up and minimize sweeping	—	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	C
Cargo hold vibrator	Vibrator mounted to the underside of the cargo hold to help with steady flow of cargo from the cargo hold	X	X	Yes	Yes	Yes	Yes	Yes	Med.	Yes	Yes	Yes	Yes	Port	P
Operational															
Maximum cargo fill height below deck	Stop filling the cargo hold when the top of the cargo is at or below the deck elevation	—	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Careful gate operation	Carefully control the cargo gates during unloading and limit the flow as necessary so that the cargo is unloaded in a steady stream	X	—	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P

TABLE 2-3

Selected Structural and Operational DCR Control Measures Selected to Reduce Ship-Generated DCR

		Ship-Implemented Control Measures		Alternative Screening Criteria					Additional Evaluative Criteria						
Measure	Description	Tunnel DCR	Deck DCR	Regulate within Existing Coast Guard Structure and Resources	Regulate without Threatening Shipping Economic Viability	Regulate without Threatening Shipping Safety	Avoid Energy Use Resulting in Little or No Reduction in DCR	Uses Proven Technology	Effectively Minimize DCR (High, Medium, Low)	Operate without Specialized Equipment or Training	Function in Adverse Weather	Apply to Most Particle Sizes and Cargo Types	Operate without Additional Shoreside Support	Use at Port and in Transit	Prevention (P) or Capture (C)
Start/stop loading operation	Start/stop unloading operation by stopping conveyor or other mechanism while the ship, conveyor belt, or other equipment is repositioned	—	X	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Delay loading/ unloading during high winds	Stop loading or unloading operations during high winds to prevent windblown DCR	—	X	Yes	Yes	Yes	Yes	Yes	Med.	Yes	Yes	Yes	Yes	Port	P

In summary, the following structural DCR control measures are included in this alternative:

- Enclosed conveyors for the unloading boom that prevent DCR on the deck during unloading operations
- Conveyor skirts along the unloading conveyors (unloading boom and tunnel conveyor) to prevent cargo from spilling off the sides of the conveyor belt
- Belt scrapers on the unloading conveyors that minimize material sticking to the conveyor belts and falling on the deck on the return path of the conveyor belt
- Brooms and shovels to collect fallen material
- Troughed conveyor belts that are U-shaped to minimize DCR from the sides
- Tarp placed on deck in small areas of high spillage during loading or unloading to facilitate post-operation clean up and minimize sweeping
- Cargo hold vibrator mounted to the underside of the cargo hold to provide a steady flow of cargo from the hold to the unloading conveyor

The structural control measures included in this alternative are proven in the shipping industry and have been implemented in some capacity in the Great Lakes fleet for various cargo types. They have been successfully retrofitted to older self-unloading ships, and, therefore, demonstrated to be economically viable in many cases.

The following operational control measures proven to prevent or capture deck DCR and, thus, reduce DCR sweeping are included in the alternative:

- Restrict the maximum cargo fill height of the cargo holds to below the deck elevation to prevent spillage from "topping off"
- Careful control of cargo hold gates during unloading so that the cargo is unloaded in a steady stream and limited, as necessary, so that tunnel spillage is minimized
- Start and stop the loading operation by stopping conveyor or other mechanism while the ship, conveyor belt, or other equipment is repositioned
- Delay loading/unloading during high winds to prevent wind-blown DCR

These control measures have been successfully applied to several operations on the Great Lakes and therefore demonstrated to be economically feasible in many if not all cases. Costs were estimated for each control measure and are provided in Table 2-4. These costs were developed with input from the shipping industry, input from equipment suppliers, and engineering judgment. They have varying levels of uncertainty because each ship and its operation is unique and there are limited cost data available from a limited number of manufacturers and installation companies**.** Even greater uncertainty exists with operational costs as described in Table 2-4.

TABLE 2-4
Estimated Preliminary Cost of Ship DCR Control Measures

DCR Control Measure	Use on Deck	Use in Tunnel	Cost ($000s)				Notes/Uncertainty
			Capital	Installation	O&M	Delay	
Structural Control Measures							
Enclosed conveyor	Yes	No	95	45	18	45,[a] 75[b]	Medium uncertainty. LCA estimate without verification, but for a technology in use. LCA notes ancillary costs that are not included in estimate
Conveyor skirts	Yes	Yes	36	55	4	—	Low uncertainty. LCA estimate for a technology in use
Belt scrapers	Yes	Yes	32	32	5	—	Low uncertainty. LCA estimate for a technology in use. Independently verified capital cost
Broom and shovel	Yes	Yes	1.25	—	1.25	120[a] (loading), 360[b] (loading), 0 (unloading)	Low uncertainty. Although costs may vary from ship to ship based on management practices, type of conveyors and amount of residue, the costs are predictable
Troughed conveyor	Yes	Yes	1,300,[a] 2,500[b]	Included in capital cost	65,[a] 125[b]	—	Low uncertainty. LCA estimate for a technology in use by most U.S. flag vessels
Deck tarps	Yes	No	2	—	5	—	Low uncertainty. Assume tarps are located underneath unloading conveyor on ship deck, not needed between *each* hatch
Cargo hold vibrator	No	Yes	95	125	8.4	—	Low uncertainty. LCA estimate for a technology in use
Operational Control Measures							
Maximum cargo fill height below deck	Yes	No	—	—	Additional trips, etc.[d]	—	—
Careful gate operation	No	Yes	—	—	—	—	Likely to result in cost savings by minimizing residue

TABLE 2-4
Estimated Preliminary Cost of Ship DCR Control Measures

DCR Control Measure	Use on Deck	Use in Tunnel	Cost ($000s)				Notes/Uncertainty
			Capital	Installation	O&M	Delay	
Start/stop loading conveyor	Yes	No	No equipment cost[c]	No installation cost[c]	—	Delay costs highly variable, depending on port size, cargo type, and number of operations per year	High uncertainty because of highly variable costs
Delay loading/unloading during "high" winds	Yes	No	No equipment cost[c]	No installation cost[c]	—	126,[a] 210[b]	High uncertainty. Uncertainty over definition of "high winds" and frequency of stoppage

Sources: Schultz, personal communication, 2007. Cooper, personal communication, 2007. Midwest Rake Company, LLC, 2007. United States Plastic Corporation, 2007. Tarps Plus, 2007. Lake Carriers' Association, 2007.
[a] Small ship: Classes V, VI, VII, and VIII; ~600 to 849 feet.
[b] Large ship: Classes IX and X; ~850 to 1,100 feet.
[c] The BMP may not have an associated cost. However implementing the BMP may "cost" the ship or shoreside facility money by delaying loading or unloading, ultimately reducing the efficiency of the cargo movements.
[d] Approximately 16 additional trips by midsized ships would be needed to transport the excess coal cargo, which equals approximately $380,800 in additional loading and unloading costs (14 hours per each of 16 medium-sized ships). These costs would be distributed among the U.S. and Canadian shipping industry as a whole (carriers, suppliers, buyers) and not be restricted to individual ships.

2.6 Alternative 5—Proposed Action with Shoreside DCR Control Measures

2.6.1 Introduction

Under the Proposed Action with Shoreside DCR Control Measures alternative, the Coast Guard would permanently adopt the IEP, require recordkeeping, and implement shoreside DCR control measures to limit the amount of DCR that falls on the ship deck from loading operations. By reducing the main source of DCR on deck, the alternative would minimize cleanup requirements and subsequent DCR sweeping from vessels. Recordkeeping would be required as part of this alternative.

This alternative differs from the Proposed Action with DCR Control Measures on Ships alternative in that control measures would be required only at shoreside facilities. Shoreside stormwater management measures are not included because runoff from ports facilities is regulated by state agencies through the Clean Water Act and through stormwater pollution prevention plans that ensure shoreside facilities are minimizing stormwater pollution. Thus, they are not of part of the purpose of and need for this action.

Structural and operational shoreside DCR control measures are in place at many Great Lakes ports with varying degrees of implementation, depending upon facility age, the technological generation of the facility's loading equipment, shoreside loading mechanisms, cargo type and port origin and destination, and the general loading operation and policies, including state stormwater requirements. Because some shoreside facilities have been in service for more than 50 years and because Great Lakes ports handle various cargo types, there is variability between ports in the types of loading equipment and control measures in place to reduce residue on ship decks.

Shoreside structural and operational control measures that prevent DCR during the loading operation are summarized in Appendix E. This appendix includes a description of control measures used in varying capacity throughout Great Lakes ports and an evaluation of the control measures using the criteria and methods described in Section 2.5.1 for the Proposed Action with DCR Control Measures on Ships alternative. The results of the comparison are presented in Section 2.6.2.

2.6.2 Description of Proposed Action with Shoreside DCR Control Measures Alternative

Five structural and three operational control measures are included in this alternative (Table 2-5). The five structural control measures are proven in the Great Lakes shipping industry with a demonstrated ability to reduce DCR for a variety of cargo types. The control measures have been successfully retrofitted to older self-unloading ships; therefore it is expected that shoreside facilities could be similarly retrofitted. The structural control measures included in the alternative are:

- Enclosed conveyors for the loading boom to prevent DCR on the deck during loading operations

- Troughed conveyor belts that are U-shaped to minimize DCR from the sides
- Conveyor skirts along the loading conveyor to prevent cargo from falling off the sides of the conveyor belt
- Belt scrapers on the loading conveyors to minimize material sticking to the conveyor belts and falling on the deck on the return path of the conveyor belt
- Loading chute at the end of a conveyor belt to direct cargo into the cargo hatch

The three operational DCR control measures would reduce the amount of DCR from wind, rain and other environmental factors, personnel differences between ports, port loading operations and loading equipment type, and the ability of the ship and loading equipment to be positioned accurately over the cargo holds. The operational control measures to reduce DCR on the deck during loading operations include the following:

- Delay loading during high winds or when poor weather conditions create windblown DCR
- Require loading conveyor/chute to discharge below the deck and as close as reasonably possible to the top of the cargo
- Start and stop the loading conveyor while the ship or the conveyor belt is repositioned over each cargo hold

See Table 2-6 for costs estimated for each control measure. The estimates have similar uncertainties as those described above for DCR control measures on ships. In addition, variability among ports is even greater than the variability among ships, which produces greater variation and uncertainty in the cost estimates.

2.7 Comparison of Alternatives

The impacts of each alternative are described in Chapter 4 and compared in Chapter 7. (See Table 7-2 for a comparison of the alternatives.)

TABLE 2-5
Selected Structural and Operational Control Measures Implemented Shoreside to Reduce DCR

BMP	BMP Description	Alternative Screening Criteria: Regulate within Existing Coast Guard Structure and Resources	Regulate without Threatening Shipping Economic Viability	Regulate without Threatening Shipping Safety	Avoid Energy Use Resulting in Little or No Reduction in DCR	Use Proven Technology	Additional Evaluation Criteria: Effectively Minimized DCR (High, Medium, low)	Operate without Specialized Equipment or Training	Function in Adverse Weather	Apply to Most Particle Sizes and Cargo Types	Operate without Additional Shoreside Support	Use at Port and in Transit	Prevention (P) or Capture (C)
Structural													
Enclosed conveyor	Covers installed on the loading or unloading conveyors to prevent DCR	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Troughed (U-shaped) conveyor	Conveyor belts that are U shaped to minimize DCR from the sides	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Conveyor skirts	Skirts installed at gate openings, along the length of conveyor belts, or at the bottom of cargo holds to reduce DCR from falling over the side of the conveyor	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Belt scrapers	Metal or synthetic scrapers that rub against the conveyor belts to dislodge cargo that may be stuck on the conveyor belt	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Loading chute	Device at the end of a conveyor belt that directs cargo from the conveyor belt into the cargo hatch	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Operational													
Delay loading/ unloading during high winds	Stop loading or unloading operations during high winds to prevent windblown DCR	Yes	Yes	Yes	Yes	Yes	Med.	Yes	Yes	Yes	Yes	Port	P

TABLE 2-5
Selected Structural and Operational Control Measures Implemented Shoreside to Reduce DCR

		Alternative Screening Criteria					Additional Evaluation Criteria						
BMP	**BMP Description**	**Regulate within Existing Coast Guard Structure and Resources**	**Regulate without Threatening Shipping Economic Viability**	**Regulate without Threatening Shipping Safety**	**Avoid Energy Use Resulting in Little or No Reduction in DCR**	**Use Proven Technology**	**Effectively Minimized DCR (High, Medium, low)**	**Operate without Specialized Equipment or Training**	**Function in Adverse Weather**	**Apply to Most Particle Sizes and Cargo Types**	**Operate without Additional Shoreside Support**	**Use at Port and in Transit**	**Prevention (P) or Capture (C)**
Loading discharge point below the deck	Discharge point of loading conveyor/chute below the deck, as close as reasonably possible to the top of the cargo	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P
Start/stop loading conveyor	Stop loading conveyor belt while the ship or the conveyor belt is repositioned	Yes	Yes	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Port	P

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TABLE 2-6
Estimated Preliminary Cost of Shoreside DCR Control Measures

DCR Control Measure	Cost ($000s) Capital	Installation	O&M	Delay	Notes/Uncertainty
Structural Control Measures					
Enclosed conveyor	38	18	7.2	—	Medium uncertainty. Derived from an LCA estimate for ship conveyors. Not verified
Troughed (U-shaped) conveyor	330	Included in capital cost	16.5	—	Low uncertainty. Independent cost estimate
Conveyor skirts	8.8	13.5	1	—	Medium uncertainty. Derived from an LCA estimate for conveyor skirts on ship conveyors. Not verified
Belt scrapers	32	32	5	—	Low uncertainty. LCA estimate for a technology in use. Independently verified capital cost
Loading chute	4,000	1,000	200	—	Medium uncertainty. Independent cost estimate. Not verified. Includes telescoping option
Operational Control Measures					
Delay loading/ unloading during “high” winds	No equipment cost[a]	No installation cost	—	Delay costs highly variable, depending on port size, cargo type and no. of operations per year	High uncertainty. Uncertainty over definition of “high winds” and frequency of stoppage
Loading discharge point below the deck	No equipment cost[a]	No installation cost	—	Delay cost may include additional time to reposition discharge point. Costs shared by ships and shoreside facilities	High uncertainty, although costs expected to be relatively low. Uncertainty of costs because of variability of shoreside loading facilities

TABLE 2-6
Estimated Preliminary Cost of Shoreside DCR Control Measures

DCR Control Measure	Cost ($000s)				Notes/Uncertainty
	Capital	Installation	O&M	Delay	
Start/stop loading operation	Costs highly variable depending on # of loading mechanisms and extent of conveyor system replacement needed	No installation cost	O&M costs highly variable depending on no. of loading mechanisms, ability to start and stop during loading and conveyor system complexity	Delay costs highly variable, depending on port size, cargo type and no. of operations per year	High uncertainty because of highly variable costs

Sources: Lucas, personal communication, 2007. Cooper, personal communication, 2007. Lake Carriers' Association, 2007.
[a] The BMP may not have an associated cost. However implementing the BMP may "cost" the ship or shoreside facility money by delaying loading or unloading, ultimately reducing the efficiency of the cargo movements.

CHAPTER 3

Affected Environment

3.1 Introduction

Chapter 3 describes the environmental and socioeconomic conditions and resources most likely to be affected by the Proposed Action and other alternatives and serves as a baseline from which to identify and evaluate potential impacts. In compliance with NEPA, Council on Environmental Quality (CEQ) regulations (40 CFR 1501.7 (a) 2 and (a) 3), Coast Guard Implementing Regulations for NEPA (COMDTINST M16475.1D), and Department of Homeland Security Management Directive 5100.1, the description of the affected environment focuses on those conditions and resource areas that are potentially subject to the effects from the Proposed Action or alternatives.

For example, land-based resources that are unaffected by DCR sweepings in the Great Lakes will not undergo detailed analysis, whereas most water-based resources will. The description of conditions is a combination of information reported in the literature and site-specific studies conducted by the Coast Guard and EPA expressly for this Draft EIS and rulemaking. Scoping identifies and defines issues to be analyzed in depth in the EIS (40 CFR 1501.7 (a) 2). The guidelines also state that the implementing agency should identify and eliminate insignificant issues from detailed study (40 CFR 1501.7 (a) 3). The Coast Guard used the input from all scoping activities, including agency coordination, to identify and eliminate the following issues from detailed study. Section 3.3 describes those resources that are analyzed in depth accordingly.

3.2 Resources Dismissed from In-Depth Analysis

The following resource areas were determined to be outside the area of potential effect for all alternatives and, for the reasons given, eliminated from further study.

3.2.1 Geology, Topography, and Soils, and Hydrology and Floodplains

The alternatives under consideration involve activities affecting only the deposit of DCR on or below a ship's deck or in the water during loading or unloading, and the removal of DCR that has been deposited on deck or accumulated in the sump. Shoreside activities that might sweep DCR to the water outside of loading or unloading activities are not included, because the scope of the EIS is limited to the sweeping of DCR from vessels and not incidental discharges from port facilities. If conveyance activities changed portside, they would occur in areas that are already developed, and would not result in ground-disturbing activities. Therefore, detailed examination of geology, topography, and soils are excluded from further study.

Changes to, hydrology, and floodplains may occur because of modifications to surface water features, filling of flood-prone areas, or construction of impervious surfaces such as parking lots and highways or new ports. The alternatives under consideration would not involve modifying hydrological features, filling floodplains, or constructing impervious surfaces. The shoreside management of dry bulk cargo is not related to conveyance of cargo to ships or dry cargo sweepings, therefore, it is outside the scope of this EIS and will not be considered for analysis.

3.2.2 Air Quality

The alternatives under consideration, other than No Action, would allow the sweeping of dry cargo residues and include measures to maintain records, modify exclusion areas, or reduce the amount of such residues. Each alternative would limit the emission of particulate matter. Water would continue to be used to sweep the decks of carriers in transit and would not result in the airborne dispersal of particulate matter. Proposed DCR control measures being considered, such as troughed conveyors or curtained conveyor belts would reduce the amount of DCRs left on deck and control the dispersal of particulate matter in the port area. On a larger scale, particulate matter would continue to be associated with shoreside activities, but the particulate material is associated with all dry cargo transport and is not unique to Great Lakes transport or sweeping activities and is not expected to change significantly because of the alternatives. Since the alternatives under consideration would not affect air quality, the Coast Guard has eliminated air quality from further study.

3.2.3 Noise

Noise impacts occur when sound levels experienced by noise-sensitive receptors exceed a certain auditory threshold. Sensitive receptors include residences, recreational areas, hospitals, and schools, for example, but not industrial parks, commercial centers, marine port facilities, or other such areas. Thus, sensitive receptors are unlikely to be encountered while carriers are in transit or in port.

Underwater noise is generated by the propulsion systems of Great Lakes vessels and propeller cavitation (that is, drag on a propeller caused by the formation of air bubbles near fast-turning propeller tips). The noise levels generated depend on vessel type, size, and operational mode. Noise levels generated by propulsion and cavitation would be much higher than those resulting from dry cargo sweeping. None of the alternatives under consideration would increase underwater noise beyond current background levels, and so aquatic species would not be affected. Noise impacts to waterfowl and aquatic species have also been considered and eliminated. As such, the Coast Guard has excluded this resource area from further study.

3.2.4 Potential Hazardous Materials

The alternatives under consideration would not allow the sweeping of toxic or hazardous DCRs. There would be no change in land-based generation, storage, or handling of any hazardous materials or waste because of any of the alternatives. The alternatives would not result in the sweeping of hazardous materials or disturb potentially hazardous materials. Thus, the Coast Guard has excluded potential hazardous materials from further study.

3.2.5 Land Use and Housing

Land use and housing impacts occur when a community’s planned land use is changed or when residential relocations are necessary. The alternatives under consideration pertain to dry cargo carriers that are in transit or in port. They do not involve changes to land uses, nor would they result in an influx or displacement of residents. Thus, the Coast Guard has excluded this resource area from further study.

3.2.6 Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) requires that, before any action takes place, the implementing agency take into account the effect of the undertaking on any district, site, building, structure, or object listed or eligible for inclusion in the National Register of Historic Places (NRHP). The Coast Guard incorporated compliance with Section 106 of the National Historic Preservation Act into the NEPA process (40 CFR 1502.25). The proposed action or any alternative considered in the current EIS would not affect any terrestrial district, site, building, structure, or object listed or eligible for inclusion to the NRHP. Therefore, terrestrial cultural resources are excluded from further study.

The Coast Guard considered the potential to affect submerged historic resources. With the exception of the No Action alternative, the alternatives under consideration would allow dry cargo carriers to continue sweeping DCR into the Great Lakes. The Coast Guard researched State Historic Preservation Officer's (SHPO) websites and the National Register of Historic Places website. No submerged historic resources were identified in Pennsylvania, Illinois, and Ohio. Under Section 106 of the NHPA, for Pennsylvania, Illinois, and Ohio where no submerged historic resources were identified, the CG made a determination of "no historic properties affected".

The Coast Guard identified historic shipwrecks and a submerged historic district in the State of Michigan, and shipwrecks in Wisconsin, Minnesota, Indiana and New York. Of particular note is the Thunder Bay National Marine Sanctuary (NMS). The Thunder Bay NMS is jointly managed by the State of Michigan and NOAA. Though not all the sanctuary's contributing sites and structures are completely listed to the NRHP, they are expected to meet Criterion C are considered eligible to be listed to the NRHP. The Sanctuary is expected to be listed as an historic district. Thunder Bay NMS is the only NOAA sanctuary designated as such for the protection of maritime heritage resources. The Coast Guard applied the criteria of adverse effect for the historic district and the individual shipwrecks (36 CFR 800.5). The Coast Guard determined that there would be "no adverse effect" on these resources listed or eligible for inclusion to the NRHP. The Coast Guard contacted the SHPOs and the Thunder Bay NMS for comments and invites public input to the Section 106 process.

It is based on the determinations of no historic properties affected and no adverse affect that submerged cultural resources are dismissed from further analysis. Additional information on these determinations is available in Appendix G (Agency Consultation). However, Thunder Bay NMS, located in Lake Huron in Michigan, is unique because it is generally considered to be a submerged historic district. For this reason and because the Coast Guard's ultimate action could affect overall management efforts within the Sanctuary despite the determination of "no adverse effect", additional discussion of Thunder Bay NMS can be found in Section 3.3.2, "Protected and Sensitive Areas".

3.2.7 Visual and Aesthetic Resources

Adverse impacts can occur when the visual element of an area or its aesthetic quality is changed. This could include building a port facility in an area used for lake recreation or in a lakefront residential area. Port facilities include docks, warehouses, and other structures involved in the servicing of dry cargo carriers. Activities over water while vessels are in transit would not change. Adverse visual impacts could result from changes in the size, height, or general appearance of vessels. The alternatives under consideration would not adversely affect visual or aesthetic resources, and so the Coast Guard has excluded this resource area from further study.

3.2.8 Land-Based Traffic

Land-based traffic impacts result when traffic volumes exceed the capacity of a facility,. Impacts could include vehicular collisions or congestion that results in delays. The alternatives under consideration would occur aboard a dry cargo carrier and would not affect roadways or rail lines associated with a port facility. No impact to traffic is expected under any of the alternatives under consideration; therefore, the Coast Guard has eliminated this resource from further study.

3.2.9 Water-Dependent Recreation

Recreational boating, swimming, scuba diving, and ice fishing usually take place in nearshore areas along the Great Lakes but away from marine port facilities. Actions that would hinder or eliminate the ability of enthusiasts to enjoy or participate in such recreation would result in an adverse effect. The alternatives under consideration would occur in marine ports or areas outside nearshore recreation areas. They would not impede recreational boating, interfere with swimming or scuba diving, or affect ice-fishing activities. (Recreational fishing—as distinct from ice fishing—will be addressed in the socioeconomics discussion, Section 3.3.5.) Therefore, the Coast Guard has excluded water-dependent recreation from further study.

3.2.10 Population and Services

The alternatives under consideration pertain to dry cargo carriers that are in transit or at port and would not affect population in the Great Lakes states or port areas. Therefore, there would not be additional demand for services such as schools, police, and fire protection, and the Coast Guard has excluded these topics from further study. Other socioeconomic factors are addressed in Section 3.3.5.

3.3 Resources Included for In-Depth Analysis

3.3.1 Great Lakes Overview

Background information is provided in the following sections for the five Great Lakes and Lake St. Clair, where data are available.

The Great Lakes comprise 95,170 square miles of water surface—about 61,000 in the U.S. and 34,000 in Canada—with a 10,000-mile coastline. The land area abutting the Lakes accounted for about 9 percent of the U.S. population in 2000. Twenty-five U.S. cities with populations greater than 100,000 lie within 100 miles of a Great Lakes port. The Great Lakes represent 90 percent of the total U.S. volume of freshwater lakes and are the largest source of fresh water in the world. The Lakes provide water for more than 40 million people, with about 56 billion gallons per day used by municipalities, agricultural producers, and industries.

The Great Lakes system is a major source of revenue and employment for the region. The primary economic activities in the region are agriculture, industrial manufacturing, steel production, shipping, commercial and sport fisheries, and recreation and tourism. A study conducted for the U.S. Saint Lawrence Seaway Development Corporation (Martin Associates, 2001) estimated that 153,000 jobs were related to marine cargo and vessel activity in the Great Lakes–St. Lawrence Seaway System. Of that number, 44,000 were directly involved in moving cargo. This same study estimated that the system accounted for about $3.4 billion in business revenue at 16 U.S. ports. Revenues are dependent on the demand for these commodities.

Volumes of commodities carried are prone to annual variability, but have generally been steady or rising moderately during the ten years prior to 2008, excepting iron ore which is more variable. There has been a decline in many of the user industries in the Great Lakes, including steel, manufacturing, and construction, while others such as transportation, agriculture, and energy have been steady or growing, influenced by increased global commodities demand. Other factors for the carriers are relative freight rates, transit times, and technological and operational changes in the other modes, and decrease in water depths which reduced vessels' overall cargo carrying efficiency. There has been very little recent shipbuilding of Great Lakes dry bulk carriers, most of that being conversions to integrated tug-barge units. Overall, Great Lakes carriers are optimistic about growth in historically dominant bulk cargoes, based on prospects for the continued regional importance of manufacturing, construction and utilities. There is also a potential for new Great Lakes bulk cargo trades such as iron ore briquettes, plastic pellets and scrubbing stone (MARAD 2005).

Although the Great Lakes are connected, primarily through narrow waterways, each possesses different physical characteristics. Table 3-1 summarizes the physical features of each Lake and of Lake St. Clair, considered part of the Lake Erie watershed.

TABLE 3-1

Great Lakes Physical Features and Population

Feature/Population	Erie	Huron	Michigan	Ontario	St. Clair	Superior
Elevation (ft above sea level)	569	577	577	243	572	600
Length (mi)	241	206	307	193	26	350
Average depth (ft)	62	195	279	283	10	483
Maximum depth (ft)	210	750	925	802	21	1,332
Volume (mi^3)	116	850	1,180	393	1	2,900
Total lake surface area (mi^2)	9,910	23,000	22,300	7,340	400	31,700
Drainage area (mi^2)	30,140	51,700	45,600	24,720	4,890	49,300
Lake surface area in U.S. (mi^2)	4,977	9,111	22,300	3,560	162	20,598
Shoreline (mi)	871	3,827	1,638	712	169	2,726
Retention time (yr)	2.6	22	99	6	9 days	191
U.S. population (2004)	10,500,000	1,500,000	12,052,743	2,800,000	N/A	444,000
Lake outlet	Niagara River and Welland Canal	St. Clair River to Lake Erie	Straits of Mackinac to Lake Huron	St. Lawrence River to Atlantic Ocean	Detroit River to Lake Erie	St. Mary's River to Lake Huron

Sources: Fuller et al., 1995; GLERL, 2004.

3.3.1.1 Circulation Patterns

Beletsky et al. (1999) studied current flows and mean circulation within the Great Lakes. According to that study, the average magnitude of summer circulation in the Great Lakes is 1.0 to 2.4 cm/s with localized current velocities as low as 0.1 cm/s and as high as 7.1 cm/s. Summer circulation within Lake Huron, Lake Michigan, and Lake Superior is mostly counterclockwise.

In Lake Michigan, the mean circulation pattern is distinctively counterclockwise in the deep basins and clockwise in the midlake ridge area where current speeds reach their maximum. Water flow along the west coast is significantly weaker (current speeds of 0.5 cm/s or less) than flow along the east coast (current speeds around 1.5 cm/s). Coastal summer currents appear to be stronger in Lake Huron than in Lake Michigan (up to 2 to 4 cm/s).

In Lake Ontario, mean circulation consists of a combination of a large counterclockwise gyre, where current speed reaches its maximum of 2.5 cm/s, and a smaller clockwise gyre in the western part of the Lake.

The mean circulation pattern in Lake Erie is clockwise; however, a smaller counterclockwise gyre exists in the western portion of the Lake. The strongest summer currents in Lake Erie (4.4 cm/s) were observed south of Point Pelee, Ontario.

According to the Beletsky et al. (1999) study, summer circulation is more complex than winter circulation due to the presence of distinct air masses and frontal systems in the presence of the seasonal (summer) thermocline. Winter circulation appears to be almost entirely wind-driven and is stronger than summer circulation because of stronger winter winds. The average speed of winter currents is between 1.6 and 2.8 cm/s, while localized currents as low as 0.2 cm/s and as high as 9.5 cm/s have been recorded.

Winter circulation in Lake Huron and Lake Michigan is counterclockwise and these Lakes exhibit strong coastal currents (up to 7.9 cm/s in southern Lake Huron and 4.7 cm/s in southern Lake Michigan). The pattern of winter circulation within Lake Superior is similar to that in summer (that is, counterclockwise). The counterclockwise circulation pattern in these Lakes could be a result of the larger surface area, and stronger Lake atmosphere temperature gradients. Within Lakes Ontario and Erie, however, there are two wind-driven gyres. In Lake Erie, this two-gyre winter circulation is a result of the reversal in flow direction along the south shore from westward in summer to eastward in winter. These Lakes also have smaller surface areas (for example, Lake Ontario is three times less than that of Lakes Michigan or Huron, and four times less than that of Lake Superior) and may exhibit two-gyre circulation patterns as a consequence of more uniform wind fields.

3.3.1.2 Lake Superior

Lake Superior is the largest of the Great Lakes by surface area and volume; it accounts for more than half of all the water in the Great Lakes. Because of its volume and slow outflow, Lake Superior has a retention time—a measure of the amount of time it takes for water to flow through the Lake—of 191 years. Lake Superior's retention time is almost twice that of Lake Michigan, the Lake with the next longest retention time, and is significantly longer than all the other Lakes. It is the deepest of the Great Lakes and the coldest, as it is the only Lake north of 46 degrees latitude. Because Lake Superior is surrounded by the lowest population of the Great Lakes region and has little agricultural activity, few pollutants enter Lake Superior by runoff (EPA, 2004a).

3.3.1.3 Lake Michigan

Lake Michigan is the second largest Great Lake by volume, but it has almost the same surface area as smaller Lake Huron. Lakes Michigan and Huron are connected by the 5-mile-wide Strait of Mackinac. Lake Michigan has a retention time of 99 years and is the only Great Lake entirely within the United States. It is surrounded by one of the largest populations in the Great Lakes region. The southern part of Lake Michigan is one of the most urbanized areas of the Great Lakes, with large Lakeside cities such as Milwaukee, Chicago, and Gary. The city of Green Bay, on the northwestern edge of Lake Michigan, is one of the most productive Great Lakes fisheries but receives wastes from the world's largest concentration of pulp and paper mills (EPA, 2004a). The main source of pollution for the Lake is human activities (EPA 2004c).

3.3.1.4 Lake Huron

Lake Huron is the third largest Great Lake by volume and is almost equivalent in surface area to Lake Michigan. However, it has a retention time of only 22 years, less than one-fourth that of Lake Michigan. Lake Huron has the longest shoreline, which includes several large islands. The Saginaw River Basin is intensively farmed. Metropolitan areas along Lake Huron include Flint and Saginaw–Bay City. Saginaw Bay, on the western part of Lake Huron, has a productive fishery. Agricultural runoff and industrial runoff are the main sources of pollution for the Lake (EPA, 2004a).

3.3.1.5 Lake Erie

Lake Erie is the shallowest of the Great Lakes and the smallest by volume. It also is the warmest, although it often freezes over in winter. Lake Erie has the shortest retention time (2.6 years) of all the Great Lakes. The western part of Lake Erie is very shallow, with an average depth of only 24 feet. The Lake is surrounded by intensely farmed fertile soils and the largest human population (more than 12 million) of the Great Lakes. There are 17 metropolitan areas in the Lake Erie basin. The industrial cities of Detroit, Toledo, and Cleveland are along the western part of Lake Erie. Consequently, the Lake is exposed to large amounts of pollution from agricultural and urban runoff (EPA, 2004a).

3.3.1.6 Lake Ontario

Lake Ontario is slightly smaller than Lake Erie in surface area, but its average depth is four times greater. It has an elevation of 243 feet above mean sea level, which is more than 300 feet below that of the other Great Lakes, and a retention time of 6 years. Lake Ontario is bounded by the cities of Toronto and Hamilton, Ontario. The area surrounding the Lake is not heavily urbanized or farmed (EPA, 2004a). Roughly 80 percent of the water flowing into Lake Ontario comes from Lake Erie through the Niagara River. The balance comes from tributaries in the basin (14 percent) and precipitation (7 percent). About 93 percent of the water in Lake Ontario flows into the St. Lawrence River. Because Lake Ontario is the farthest downstream of the Great Lakes, it is affected by human activities that occur throughout the Great Lakes basin. Therefore, the other Great Lakes are the main sources of pollution for Lake Ontario (EPA, 2004b).

3.3.1.7 Lake St. Clair

Lake St. Clair is not one of the Great Lakes, but it is part of the Great Lakes system. Along with the St. Clair and Detroit rivers, it forms a connecting channel between Lake Huron and Lake Erie. Lake St. Clair has an elevation of 572 feet above mean sea level and a retention time of 9 days. It is bounded by Lambton, Kent, and Essex counties in Ontario and Macomb and Wayne counties in Michigan. The area surrounding Lake St. Clair varies from highly urbanized on the Michigan side to predominantly agricultural and recreational on the Ontario side. Ninety-eight percent of the water flowing into Lake St. Clair comes from Lake Huron through the St. Clair River, with the remaining 2 percent contributed by other Lake tributaries. Nearly 100 percent of the water in Lake St. Clair flows into Lake Erie through the Detroit River (EPA, 1989).

3.3.2 Sediments

The term "sediment" in the context of this EIS refers to the unconsolidated materials that settle at the bottom of the Great Lakes: particles of sand, clay, silt, and other substances derived from eroding soil, decomposing plants and animals, and other material. Sediments play a critical role in the recycling of nutrients in aquatic ecosystems and provide habitat for benthic, or bottom-dwelling, organisms. In the area of concern for this EIS, primarily the open waters of the Great Lakes that lie within established shipping lanes, the sediments generally consist of fine-grained particles that form a mud substrate.

The sediment environment in the Great Lakes is that area of the Great Lakes ecosystem most susceptible to potential impacts from the sweeping of DCR. This is because the DCR particles are much denser than water and thus are quickly deposited and incorporated into the sediments. Once in the sediments, the DCR particles have the potential to alter the physical and chemical nature of the sediments and thus affect the biota and ecological processes associated with the sediments.

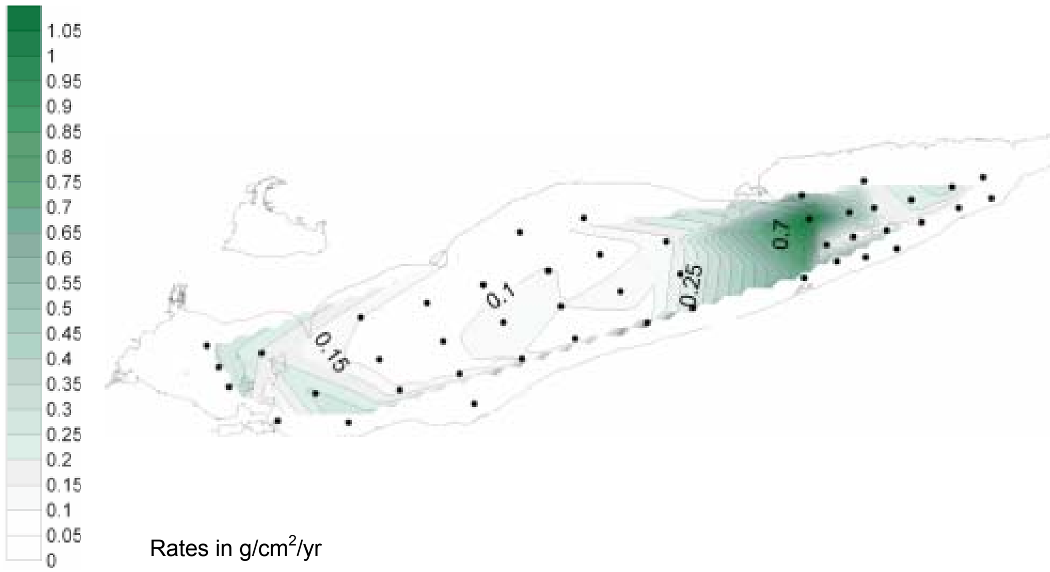
3.3.2.1 Sedimentation Rates

"Sedimentation rate" refers to the amount of native sediment that settles out of the water column to the lake bottom over a certain period. Sedimentation rates influence the burial and dilution rates of DCR. They also determine the concentration of DCR in the sediment. The greater the sedimentation rate, the greater the burial and dilution rates of DCR, because as natural sediment accumulates on the lake bottom, it creates a layer over the deposited DCR. The concentration of DCR in the sediment can determine potential chemical and physical impacts on resources. Studies have shown that sedimentation rates are highest in Lake Erie and lowest in Lake Superior (Kemp and Harper, 1976) and that sedimentation rates are greatest near the shorelines of the Great Lakes and decrease substantially in the areas farthest offshore. This is generally because of the terrestrial, or land-based, soil particles that erode and deposit in the nearshore environment.

The number of tributaries in a drainage basin does not necessarily relate to the sedimentation rate within a lake. The sediment load carried in tributaries results from land use, size of the drainage basin, soil types, and other factors. The most reliable measure of sedimentation is the direct measure of sedimentation rates within the Lakes.

The sedimentation rates presented in this section describe historic natural rates reported in the literature and are likely to continue into the future at similar rates. Sedimentation rates in Lake Erie range from 180 to more than 10,000 $g/m^2/yr$ (1 $g/cm^2/yr$), with an average of 2,300 $g/m^2/yr$ (0.23 $g/cm^2/yr$) (Klump et al., 2005). Sedimentation rates recorded near the DCR track line that runs between Cleveland and Buffalo in Lake Erie (USCG, 2002) ranged from 180 to 9,550 $g/m^2/yr$ (0.018 to 0.955 $g/cm^2/yr$) (Figure 3-1). Sedimentation rates in the three main basins of Lake Erie, where most of the Lake's sediment is deposited, are reported to have ranged from no sedimentation to 6,450 $g/m^2/yr$ (0.645 $g/cm^2/yr$) (Kemp et al., 1977). That study cited average rates of 2,160 $g/m^2/yr$ (0.216 $g/cm^2/yr$) for the western basin, 580 $g/m^2/yr$ (0.058 $g/cm^2/yr$) for the central basin, and 1,340 $g/m^2/yr$ (0.134 $g/cm^2/yr$) for the eastern basin. The higher sedimentation rates in Lake Erie reflect the Lake's high shoreline-to-volume ratio and the developed nature of the watershed.

FIGURE 3-1
Sedimentation Rates in Lake Erie Determined from a 1991 Study



Source: Klump et al., 2005.

Sedimentation rates in Lake Ontario have been reported to range from 85 to 1,225 $g/m^2/yr$ (0.0085 to 0.1225 $g/cm^2/yr$) (Kemp and Harper, 1976). Rates are highest at the eastern and western ends of the main basin. At the western end of the DCR track line, sedimentation rates range from 400 to 820 $g/m^2/yr$ (0.04 to 0.082 $g/cm^2/yr$); rates in the middle of the Lake and within the track line range from 115 to 490 $g/m^2/yr$ (0.0115 to 0.049 $g/cm^2/yr$).

Based on the data presented in Kemp et al. (1978), sedimentation rates in Lake Superior have varied from 25 to 780 $g/m^2/yr$ (0.0025 to 0.078 $g/cm^2/yr$). The sedimentation rate of 780 $g/m^2/yr$ (0.078 $g/cm^2/yr$) is a pre-1955 rate and thus is likely to best reflect the rate of accumulation of natural sediment materials in Lake Superior. A rate of 3,040 $g/m^2/yr$ (0.304 $g/cm^2/yr$) was measured at the location where taconite tailings have been released into the Duluth Basin. The lowest sedimentation rates measured were at locations farthest from the shore.

In Lake Michigan, sedimentation rates have varied from 60 to 1,015 $g/m^2/yr$ (0.0060 to 0.1015 $g/cm^2/yr$) (Edgington and Robbins, 1976). In Lake Huron, sedimentation rates ranging from 150 to 325 $g/m^2/yr$ (0.015 to 0.0325 $g/cm^2/yr$) have been reported (Kemp et al., 1974). Data from McCarthy et al. (2006) show that sedimentation rates within Georgian Bay (up to approximately 3.2 mm/yr) are much lower than those reported for the main basins of Lake Huron and the other Great Lakes. This was attributed to low sediment supply because only a few small rivers flow into Georgian Bay and most of the basin is surrounded by bedrock of Precambrian gneiss and granite to the east and Silurian dolostone, limestone, and shale to the west.

3.3.2.2 Nepheloid Layer

A nepheloid layer is a zone of water containing high concentrations of suspended sediment that is kept suspended by the interaction of current and sedimentation. Nepheloid layers are part of the Great Lakes ecosystem and may play a major role in the transport of solids and chemical substances. As a result, the nepheloid layer may be involved in the resuspension and movement of smaller DCR particles within a lake. This is important because suspended solids can affect biological productivity, ecosystem health, and the cycling of pollutants (Hawley, 2004). Also, the nepheloid layer could distribute the DCR particles to areas beyond the initial sweeping area.

The nepheloid layer's characteristics (depth at which it occurs and size) depend on several factors, including sediment density, water temperature, bottom currents, biological activity, and lake profile (for example, location, depth, and size of depositional basins). Three different types of nepheloid layer can exist: a benthic nepheloid layer (BNL), which extends upwards from the lake bottom; an intermediate nepheloid layer; and a surface nepheloid layer (Hawley, 2004). BNLs are found in all the Great Lakes (Hawley, 2004).

The BNL is found at the water–sediment interface of a lake and, as a result, is closely associated with substrate composition. The BNL is the nepheloid layer of most concern with respect to potential DCR impacts because DCR is deposited on the lake bottom where interaction with the BNL can occur. The processes responsible for the origin and maintenance of the BNL are poorly understood, however. Nepheloid layers can be present during unstratified periods, when the water in a lake is well mixed. However, they are most evident during stratification, when a thermocline, or an area where the water temperature changes rapidly with depth, creates a barrier that prevents the upper and lower waters of a lake from mixing (Chambers and Eadie, 1981; Hawley, 2004; Urban et al., 2004). Work by Hawley and Muzzi (2003) has shown that the BNL and the intermediate nepheloid layer move in response to changes in the depth of the thermocline.

Profiles by Sandilands and Mudroch (1983) indicated that a turbid, or nepheloid, layer exists at water depths greater than 60 meters (197 feet) in Lake Ontario. The thickness of the layer averaged 22 meters (72 feet) in August and September but roughly doubled to 45 meters (148 feet) in October. Investigations in Lake Michigan by Hawley (2004) have shown the presence of a BNL at water depths between 50 and 150 meters (164 and 492 feet) during the stratified period, and Shaffer (1988) observed the BNL in 160 meters (525 feet) of water in southern Lake Michigan.

Only a few studies have examined the chemical and mineralogic composition of material suspended in the BNL in the Great Lakes. Eadie et al. (1984) and Robbins and Eadie (1991) found that the chemical composition of material collected in near-bottom sediment traps closely resembled that collected from the Lake Michigan bottom. Mudroch and Mudroch (1992) found that most metals measured in the nepheloid layer were at concentrations similar to or higher than those measured in bottom sediments, and concentrations of polychlorinated biphenyls (PCBs) and the lower chlorinated biphenyls—particularly tetrachlorobiphenyls and pentachlorobiphenyls—were higher in the BNL than in sediments. A study conducted by Baker and Eisenreich (1989) found that particulate organic matter is rapidly degraded by organisms within the BNL and for the most part is not incorporated into underlying sediments.

3.3.2.3 Sediment Quality

Sediment quality is a measure of the ability of sediment to support a healthy population of benthic organisms. Sediments provide an important source of food and habitat for benthic organisms. The quality of the sediment, with respect to its chemistry, can be influenced by the deposition, dissolution, and incorporation of DCR and particles from other sources. The resulting sediment quality can influence the quality of overlying water and sediment pore water (water in the interstitial space of sediment particles) and thus the quality of the benthic and pelagic, or open-water, habitats.

Poor sediment quality, primarily resulting from land-based anthropogenic influences, is a major problem in the Great Lakes. Toxic and persistent chemicals have accumulated in Great Lakes sediments because of discharges from maritime activities, industrial facilities and sewer overflows, and from urban and agricultural runoff. The highest levels of sediment contamination generally are found in urban harbors, embayments, and river mouths along the Great Lakes. EPA (2007b) reported that sediment is the largest source of contaminants in harbors of the Great Lakes. Concern regarding sediment quality in the past has focused on shoreline areas because sediment contamination is more noticeable and measurable there than it is in deeper, offshore locations. For example, EPA (2007b) has identified 43 locations along the Great Lakes shoreline as areas of concern because of sediment contamination issues: 26 within the United States, 12 within Canada, and 5 shared by both countries. Table 3-2 (Mudroch et al., 1988) lists concentrations of key metals found in various deep-water areas of the Great Lakes.

TABLE 3-2
Metal Concentration Ranges in Sediments from Depositional Basins in the Great Lakes

Metal	Erie (µg/g)	Huron (µg/g)	Michigan (µg/g)	Ontario (µg/g)	St. Clair (µg/g)	Superior (µg/g)
Arsenic	0.45–12.3	14.7–54.0	5.0–15.0	0.2–17.0	2.5–3.4	—
Cadmium	0.8–13.7	0.3–4.3	0.05–1.8	0.1–6.2	1.4	1.4–2.5
Chromium	12–362	5.5–86.4	140	8.0–133	1.0–275	29.5–60.2
Copper	5–207	3.3–78	54	26–109	2.0–48.0	113–173
Iron	1.1–7.79	0.47–5.11	—	2.41–9.62	—	4.91–5.76
Lead	6–299	3.0–151.4	10–130	7.0–285	7.0–67.0	74.9–138.21
Mercury	0.045–4.8	0.01–.805	0.030–0.380	0.140–3.95	0.30–10.28	0.094–0.160
Nickel	16–150	5.3–96.7	25	29.0–99.0	5.0–43.0	28.9–66.4
Zinc	18–536	8.2–233	40–350	87–3,507	8.0–107.0	143–195.2

Note: µg/g equals micrograms of metal per gram of sediment.
Source: Mudroch et al., 1988.

To evaluate sediment quality in specific areas of potential future DCR sweeping (which are also the areas of high historic sweeping), sediment samples were collected in May 2007 from shipping DCR track lines with areas of historically high DCR sweeping rates (two in Lake Superior, one in Lake Michigan, and two in Lake Erie), as described in Appendices H, I, and J. These data will support the assessment of potential changes in sediment quality for the Proposed Action and alternatives. The samples were analyzed for chemical and physical parameters and tested for toxicity to aquatic organisms. Each track line sampling area consisted of a DCR sweeping area and a reference area well outside of the track lines and DCR sweepings. Table 3-3 summarizes the results for inorganics (metals and cyanide) in sediment samples and presents sediment quality benchmarks for comparison. Table 3-4 summarizes the results for polycyclic aromatic hydrocarbons (PAHs) in the DCR track line samples. The sediment benchmarks used were the freshwater consensus-based threshold effects concentrations from MacDonald et al. (2000). Threshold effects concentrations are concentrations below which adverse effects are not expected. The results indicate sediment concentrations very similar within and outside of track lines and similar to values reported in the literature (Appendix H).

There are even indications that for certain metals, the sediment concentrations are lower in areas of DCR sweeping. This may be due to both sedimentation rates varying from location to location, as shown in Figure 3-2, as well as metal concentrations in DCR material being at lower levels than in naturally occurring sediments. Clyne (2000) evaluated metal concentrations in DCR sweeping areas in Lake Ontario and observed that average concentrations in sediments with DCR were significantly lower than average metal concentrations in reference area sediments. The lower metal concentrations in DCR sweeping area sediments were attributed to the relatively high density of DCR particles, which had lower metal concentrations than sediments in the reference area. This conclusion is supported by comparing concentrations in the sediment samples collected by Clyne (2000) to concentrations in DCR solids collected in October 2006 (Table 3-5 and Appendix L). For all parameters measured, metal concentrations in sediments were higher than in DCR solids.

Sediment samples also were collected from shipping lanes for toxicity testing to determine whether the sediments were toxic to benthic organisms (Appendix L). Survival and growth were measured for each test species. Although results from both DCR sweeping areas and reference areas showed survival and growth differences significantly below the laboratory control for many samples, there were few differences between the DCR sweeping areas and the reference areas. The results of the testing are presented in detail in Appendix I.

TABLE 3-3
Inorganic Concentration Ranges in Sediments Collected in Spring 2007

		Erie		Michigan		Superior	
Inorganic	Sediment Benchmark	DCR Sweeping Areas	Reference Areas	DCR Sweeping Area	Reference Area	DCR Sweeping Areas	Reference Areas
Aluminum	NA	24,700–33,100	26,000–37,700	16,500–22,200	13,000–16,00	26,700–34,700	28,500–34,100
Arsenic	9.79	4.83–13.2	5.35–9.8	7.74–14.4	7.9–11.1	13.8–51.4	17.3–28.6
Cadmium	0.99	1.35–3.08	1.84–2.53	1.36–2.32	0.794–1.52	2.02–2.84	2.03–2.82
Calcium	NA	8,360–92,400	10,500–28,300	46,100–55,100	32,500–51,300	8,760–9,140	8,450–8,750
Chromium	43.4	38.3–68.2	47.9–60.6	33.8–49.4	23.7–39.9	40.9–61.5	42.2–52
Copper	31.6	32.1–56.3	42.9–48.6	31.4–49.9	23.3–36.7	76.8–128	80.5–134
Total cyanide	NA	ND–6.8	ND	ND	ND	ND	ND
Iron	NA	27,700–44,600	34,400–49,300	22,000–29,400	17,600–23,300	48,900–64,700	49,200–52,700
Lead	35.8	32.2–64.7	41.7–52.7	68.3–112	47.4–65.2	34–63.5	42.6–69.5
Magnesium	NA	8,930–31,700	13,100–18,900	29,000–33,900	20,900–31,400	12,400–14,800	12,900–14,600
Mercury	0.18	0.0684–0.352	0.128–0.399	0.042–0.11	0.0358–0.0942	0.0769–0.135	0.124–0.134
Nickel	22.7	37–67.2	45.2–58	32.6–51.3	20.3–29.9	36.6–45.5	40.4–42.2
Selenium	NA	ND–2.33	ND–1.45	1.16–2.14	ND	ND–1.56	ND–1.5
Silver	NA	ND—1.26	ND—0.885	ND	ND	ND–0.704	ND–0.647
Zinc	121	125–214	179—240	110–190	73.5–143	133–166	140–174

Note: Concentrations in μg/g. NA, not available; ND, not detected. μg/g equals micrograms of metal per gram of sediment.

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TABLE 3-4
PAH Concentration Ranges in Sediments Collected in Spring 2007

		Erie		Michigan		Superior	
PAH	Sediment Benchmark	DCR Sweeping Areas	Reference Areas	DCR Sweeping Area	Reference Area	DCR Sweeping Areas	Reference Areas
1-Methylnaphthalene	NA	12–31	14–24	8.2–19	6.7–20	ND–17	ND–14
2-Methylnaphthalene	NA	14–44	17–30	12–28	9.7–32	8.8–24	11–20
Acenaphthene	NA	3.6–9.2	4.7–8.7	7.3–14	4.8–18	ND–6	ND–4.2
Acenaphthylene	NA	6.2–20	16–19	6.5–12	4.1–23	4–7.8	3.7–6.6
Anthracene	121	13–27	18–25	20–40	12–58	4.8–19	6.3–15
Benzo(a)anthracene	108	62–100	84–100	66–130	43–160	17–65	18–51
Benzo(a)pyrene	150	78–130	94–120	75–150	47–170	19–64	21–51
Benzo(b)fluoranthene	NA	140–260	180–260	130–250	86–280	65–120	66–98
Benzo(g,h,i)perylene	NA	69–120	77–100	62–130	47–140	32–53	31–47
Benzo(k)fluoranthene	NA	58–110	60–79	42–110	32–95	19–42	19–36
Chrysene	166	110–180	130–160	85–180	59–210	31–77	34–63
Dibenz(a,h)anthracene	33	20–30	19–28	16–33	12–38	8.9–15	9–14
Fluoranthene	423	140–210	170–200	150–300	95–390	36–130	41–99
Fluorene	77.4	10–18	13–17	9.3–18	6.2–27	ND–9	3.6–6.6
Indeno(1,2,3-cd)pyrene	NA	63–110	71–97	57–120	44–130	35–51	35–59
Naphthalene	176	ND–46	ND–43	17–37	14–55	9.1–22	11–18
Phenanthrene	204	56–110	65–97	91–190	62–210	21–80	26–62
Pyrene	195	130–210	160–190	130–270	81–300	27–110	31–82

Note: Concentrations in µg/g. NA, not available; ND, not detected. µg/g equals micrograms of metal per gram of sediment.

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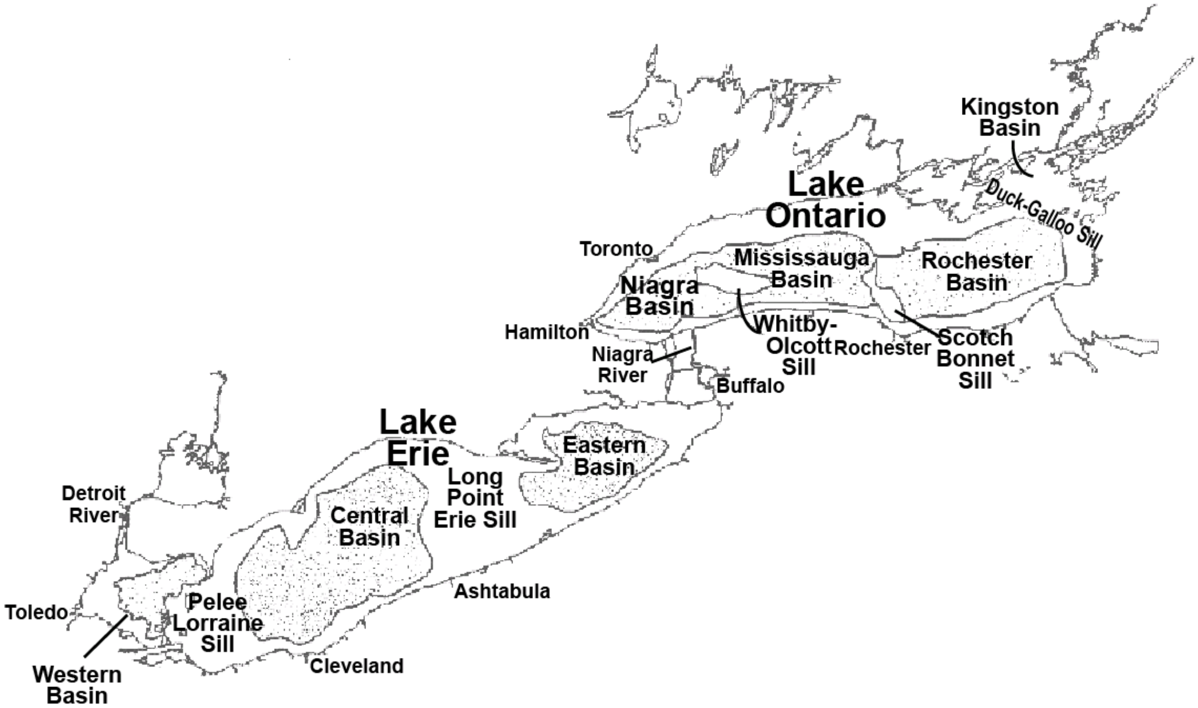
FIGURE 3-2
Depositional Areas within Lakes Erie and Ontario



Source: Marvin et al., 2002.

TABLE 3-5
Comparison of Inorganic Concentrations in DCR and Sediment from Previous Investigations

DCR or Sediment Type	Chromium	Copper	Lead	Nickel	Zinc
Coal deck DCR samples	10.65	17.13	5.98	10.45	28.88
Coal DCR sump solids	9.9	14.8	2.67	4.56	15.8
Limestone deck DCR samples	3.33	2.87	7.78	5.12	8.82
Limestone DCR sump solids	5.69	4.32	1.12	9.73	23.38
Taconite deck DCR samples	10.15	2.83	0.93	2.68	6.07
Taconite DCR sump solids	9.34	4.28	4.11	3.55	30.51
From Clyne (2000)					
Average reference area sediment concentration	81.29	119.71	91.43	98.86	303.71
Average DCR sweeping area sediment concentration	65	105	70	91.5	264

Note: Concentrations in µg/g.
Source: Appendix L.

3.3.2.4 Physical Characteristics

Sediment grain size is an important parameter for determining the type of benthic community because it reflects the physical structure of the habitat. Grain size also influences the hydrologic properties of the sediment and the distribution and bioavailability of chemicals, and can define the oxidation-reduction boundary. The addition of DCR may result in sediment with larger grain sizes and a benthic community with more organisms that prefer coarse sediment textures.

In general, sediments in deeper Great Lake waters (where most shipping and potential sweeping of DCR occurs) are composed of finer-grained particles. For most of Lake Superior, storm wave activity prevents the accumulation of fine-grained sediments in water less than 100 meters (328 feet) deep, with the exception of river mouths, such as that of the Nemadji River (Huff, 2002). Around river mouths, silt and clay-size particles have been found in water as shallow as 20 meters (66 feet) deep (Huff, 2002). Finer-sized particles are expected to settle out in deeper, undisturbed basins. This natural phenomenon, where finer grain-size particles settle out in deeper basins, is likely to occur in each of the Great Lakes.

As described in Section 3.3.2.3, sediment samples were collected from five shipping track lines where DCR was found (two in Lake Superior, one in Lake Michigan, and two in Lake Erie) and analyzed for physical parameters (Appendix L). In general, the grain sizes in DCR sweeping areas were similar to those of sediment in reference areas and not similar to the grain size of deck DCR samples, which were typically larger than 0.05 mm, with some exceptions. Overall, the grain size of DCR sweeping area sediment samples from Lake Michigan appeared larger and more similar to deck DCR sample grain sizes than did the sediment grain sizes from other Lakes.

The Great Lakes National Program Office (GLNPO) conducted benthic invertebrate sampling with associated sediment size analysis in each of the five Great Lakes in 1998 (EPA, 2007c). Sampling depths within the Lakes ranged from 12 to 257 meters (approximately 39 to 843 feet), and substrates were characterized by varying proportions of silt, clay, and fine sand. Sites in Lakes Erie and Superior had a lower percentage of fine sand; however, no substantial differences existed Lake to Lake. Finer substrates, such as silt and clay, were found in greater proportions with increasing depth, whereas proportions of sand decreased with increasing depth (EPA, 2007c).

3.3.2.5 DCR Deposition Rate

Distribution of DCR

Dry cargo transport and sweeping of DCR has been a feature of the Great Lakes for over 100 years. Thus, the presence of DCR on the lakebed is an element of existing sediment conditions that must be considered before effects of various DCR management alternatives can be evaluated. USCG (2002) and USCG (2006) each described the intensity of DCR sweeping in each area of each Lake over the course of one shipping season, the 2000-2001 and 2004-2005 seasons, respectively. Reported DCR sweepings were unevenly distributed among the Lakes (USCG, 2002). Additional deposition information can be found in the USCG (2002) report. For example, most taconite residue was swept in Lake Superior. However, coal residue was more evenly distributed, with substantial sweepings to Lakes Superior, Erie, Huron, and Michigan. Lake Huron had the highest reported sweepings of stone, but substantial stone deposits also were reported in Lake Michigan and Erie. The smallest percentage of reported DCR sweeping occurred in Lake Ontario.

When mass per unit area was calculated, Lake Erie had a higher value than Lake Superior, even though freighters swept more taconite DCR mass into Lake Superior than into Lake Erie. A comparison of average DCR sweeping mass per acre of track line is shown in

Tables 3-6 and 3-7 (USCG, 2002). DCR sweeping mass per acre values were calculated based on discrete track line segments that were established for each Lake for analyzing the distribution of DCR sweeping (USCG, 2002). These segments follow the shipping lanes and have a width of 1, 2, or 10 miles. Average track line DCR per acre by Lake, including the highest and lowest track line DCR abundance, is shown. For comparison, the highest track line DCR density (coal in Lake Erie) was equivalent to approximately 3 cups of coal being evenly distributed over a football field.

TABLE 3-6
The Average Track Line DCR per Area by Lake over the 2000–2001 Shipping Season

Lake	Iron (lb/acre)	Coal (lb/acre)	Limestone (lb/acre)
Erie	0.657	1.078	0.482
Huron	0.147	0.120	0.267
Michigan	0.402	0.172	0.291
Ontario	0.109	0.110	0.000
Superior	0.102	0.058	0.004

Note: From estimates of U.S. and Canadian vessels based on voluntary industry recordkeeping. DCR expressed on a per-acre basis for vessel sweeping. The sweeping data refer only to the areas encompassed by each washdown segment for vessels, not for the Lake as a whole.
Source: USCG, 2002.

TABLE 3-7
Highest and Lowest DCR per Area by Location

	Iron (lb/acre)	Coal (lb/acre)	Limestone (lb/acre)
High			
Track line location	Michigan MS1	Erie EFE1	Erie E0
Highest	3.577	4.199	2.075
Low			
Track line location	Erie EFE2	Superior SC	Erie EFE1, EFE2, Ontario
Lowest	0.050	0.021	0.000

Note: See USCG (2002, Figure 4-8) for locations of track lines within Lakes. Michigan MS1: Lake Michigan, far south; extending northeast to southwest. Erie EFE1, EFE2: Lake Erie, far east; extending northeast to southwest. Erie EO: Lake Erie, far west; extending east to west. Superior SC: Lake Superior, central; extending east to west. Ontario: Lake Ontario, entire; extending northeast to southwest.
Source: USCG, 2002.

Based on the reported data on DCR sweeping , a range of deposition rates representing sweeping practices throughout the Great Lakes was identified (U.S. Department of Transportation et al., 2006; USCG, 2002). The Lake areas receiving DCR sweeping (Lake Superior: SWT, SET1; Lake Michigan: MS1, MS2; Lake Erie: E0, EW1, EE, EFE1; and Lake Huron: HN1) are shown in the “Scientific Plan for Dry Cargo Sweepings Impact Analysis” (U.S. Department of Transportation et al., 2006) and included as Appendix M. Based on the reported data, cargo types, and the relative magnitude of DCR sweeping, selected areas were identified for additional investigation (Appendix K).

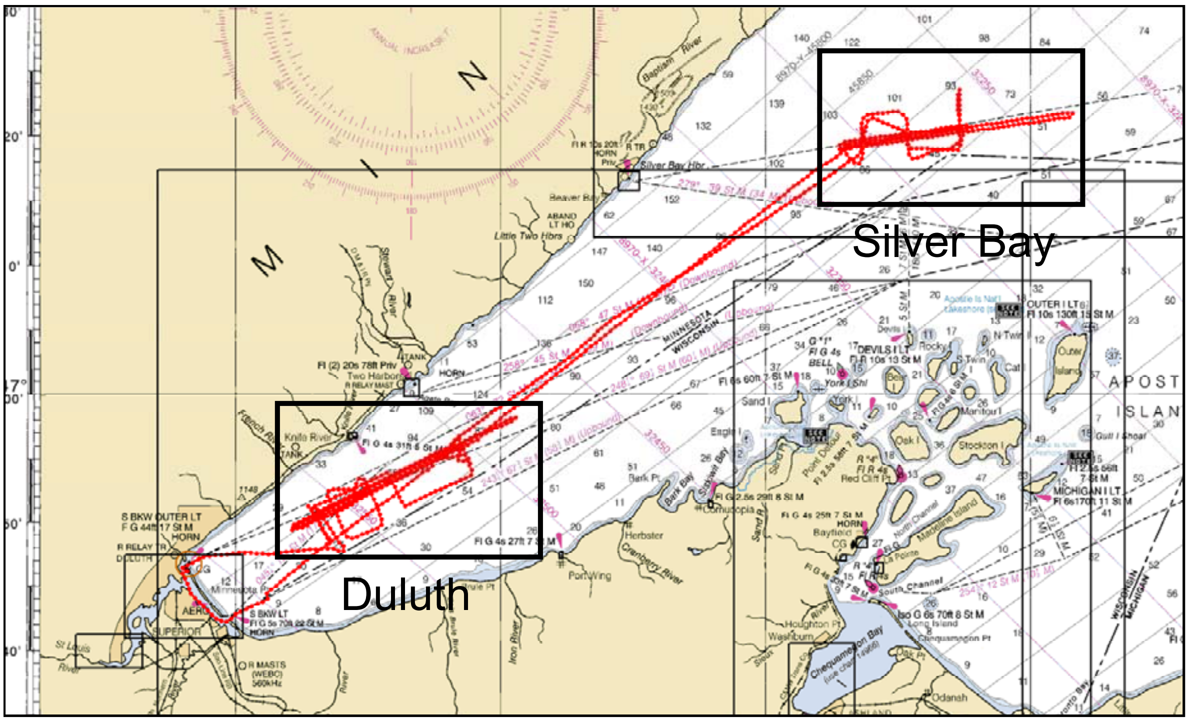
Scientific Investigations of DCR Deposition

Previous studies investigated DCR sweeping but did not address the fate of the material within the Lake. To address this issue, a scientific investigation was conducted to determine the potential accumulation of DCR sweeping as well as sediment quality and its physical characteristics. The investigation consisted of plotting the actual coordinates of DCR sweeping documented from USCG (2002) and USCG (2006) and mapping the areas of greatest sweeping using sidescan sonar (Appendices J and M). The effectiveness of sidescan sonar mapping in detecting DCR depositions in the Great Lakes has been previously demonstrated (Ferrini and Flood, 2001; Maher, 1999).

DCR Mapping

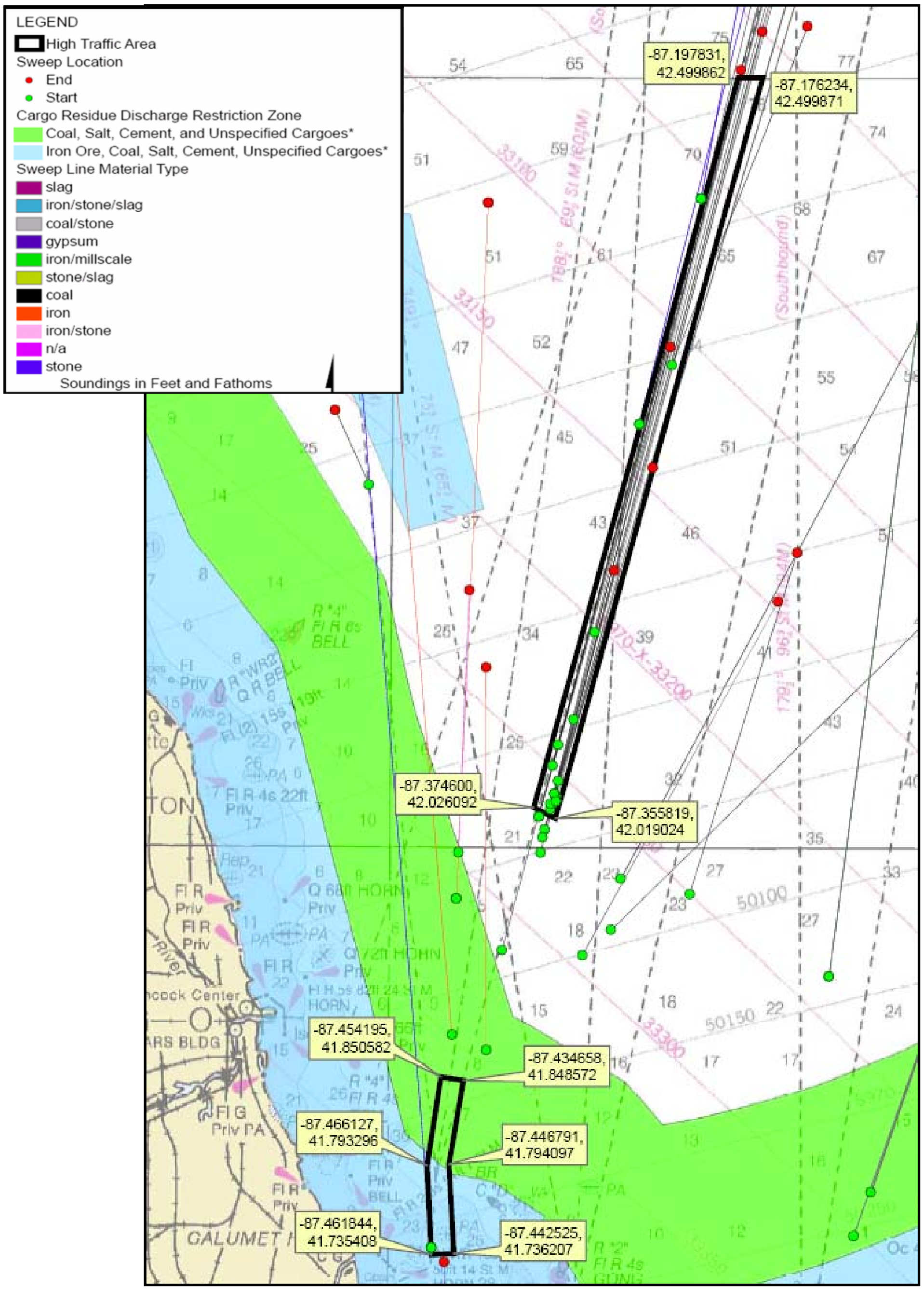
More than 485 miles (781 km) of sidescan sonar data were collected from six survey sites on three Great Lakes to identify, map, and characterize DCR deposits on the lakebed. Figures 3-3 through 3-5 show the study areas where data were collected. More-detailed maps can be found in Appendix I.

FIGURE 3-3
Navigation Plot Showing Location of Lake Superior Sonar Mapping Survey Sites



Note: The Duluth survey site is northeast of Duluth, and the Silver Bay survey site is east of Silver Bay. Red lines indicate sonar track lines.

FIGURE 3-4
Outline of Lake Michigan Primary and Secondary Sonar Mapping Survey Sites



Note: Figure shows locations along with historical sweepings activities and coverage densities.

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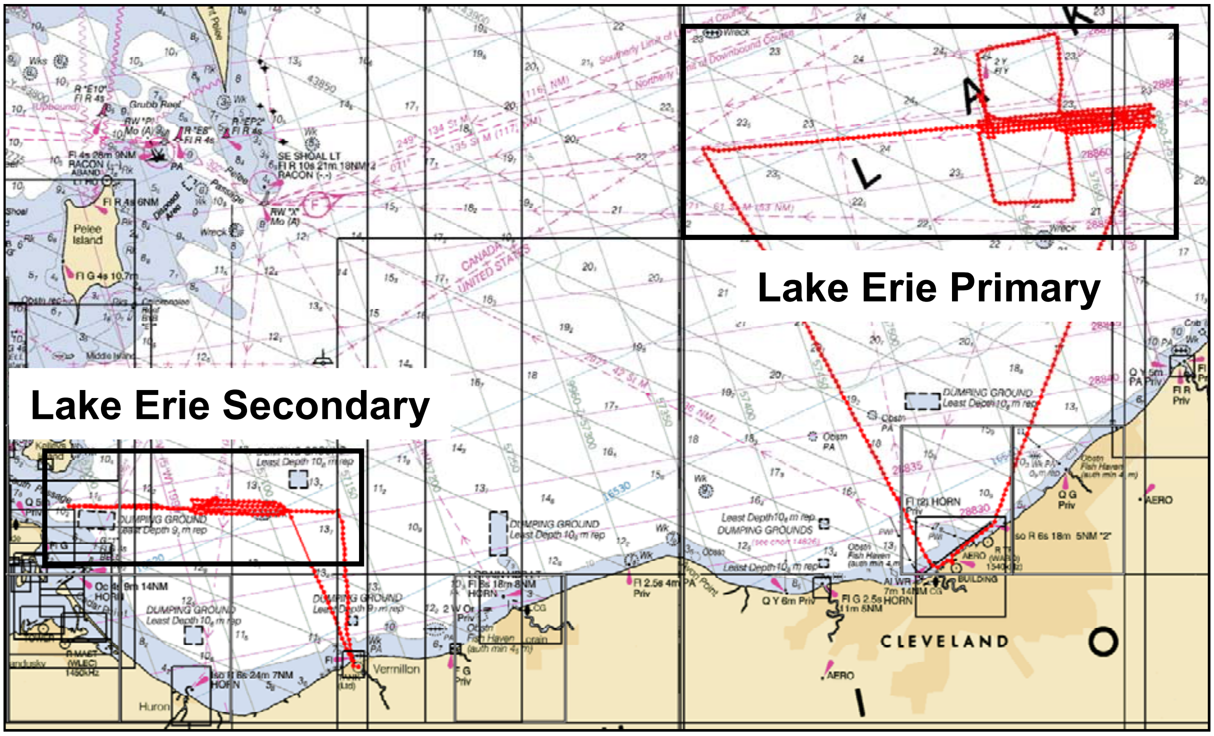
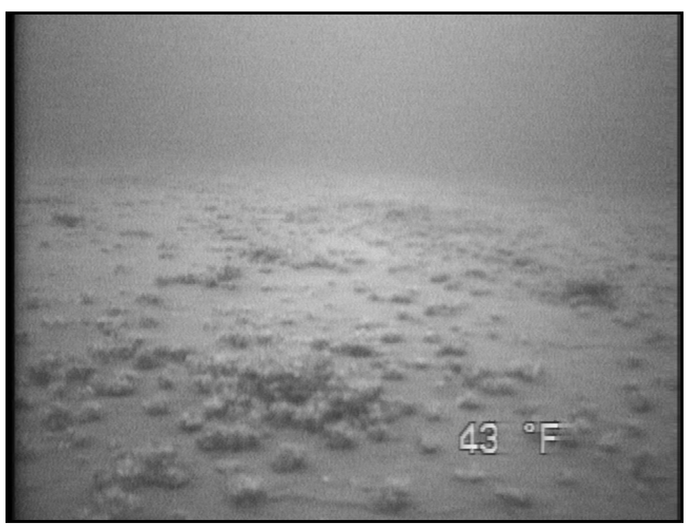
FIGURE 3-5
Navigation Plot Showing Location of Lake Erie Sonar Mapping Survey Sites



Note: Red lines indicate sonar track lines.

The six areas mapped range from 11 to 38 square miles. Sidescan sonar data were collected from Lakes Superior, Michigan, and Erie between September 19 and October 19, 2006. As discussed previously, coal, taconite, and limestone are the dominant materials swept on the Great Lakes. These materials have high acoustic impedances, which make them visible to acoustic survey tools such as sidescan sonar when deposited on soft lake bottom sediment. Methods and results of this survey are outlined below and discussed further in Appendix I.

FIGURE 3-6
Underwater Photograph of DCR Deposit in Lake Michigan Primary Sample Site 1
DCR ranges in size from a few millimeters to a few inches.



Deposition Mapping Results

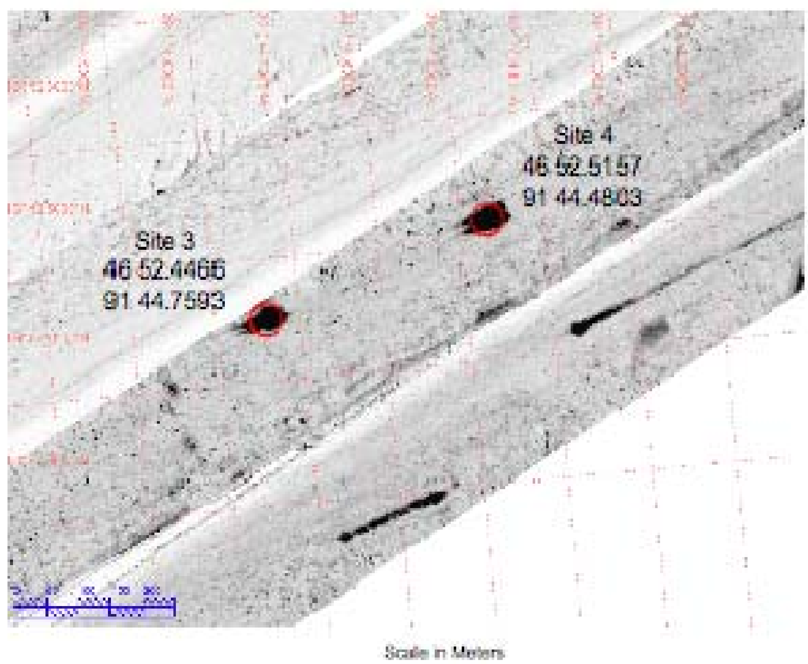
Distinct acoustic anomalies were identified in five of the six survey locations. The anomalies often were similar in pattern to those seen in previous scientific investigations (Ferrini and Flood, 2001). To further investigate the anomalies, they were characterized using underwater video and sediment grab sampling, which involves the collection of samples from approximately the upper 6 inches of sediment using a mechanical sampling device. Analysis of sediment grab samples identified DCR materials in the five survey areas with acoustic anomalies.

Figure 3-6 is an image of the Lake Michigan Primary Survey Area where significant acoustic anomalies were observed. Surficial lake bottom material potentially made up of DCR is visible in the image of Site 1. The thickness of DCR material cannot be determined with the sonar technique. However, in some instances the sonar technique was able to demonstrate some potential DCR deposits buried as many as 10 cm below the lake bottom.

Descriptions of acoustic anomalies observed during sonar mapping are included in Appendix I. The regional distribution of DCR was evaluated by developing a “linear density” measure that provides a quantitative measure of the number of targets or acoustic events per kilometer of survey line. Areas with a large number of targets have a higher linear density and smaller average spacing.

Typically, several survey lines oriented along known shipping lanes were surveyed to assess the linear distribution of sweepings deposits. Based on these initial surveys, several perpendicular survey lines were run to identify the potential lateral extent of deposition. An important finding of this work is that acoustic anomalies were widespread across all of the areas surveyed and thus is not confined exclusively to the designated shipping lanes. This finding suggests that historical shipping practices resulted in a widespread distribution of DCR across the lake bottom. Sites without acoustical targets (and thus no presumed DCR deposition) exist but do not represent all areas several miles outside shipping lanes.

FIGURE 3-7
Sites 3 and 4 Acoustic Backscatter Anomalies Present in Both Low- and High-Frequency Sidescan Sonar Data Records



Sediment samples taken at the Lake Superior Duluth survey site in October 2006 confirmed the ability of the sidescan sonar equipment to accurately identify and locate sweepings deposits on the lakebed. Figure 3-7 shows two sites where sidescan sonar displayed distinct acoustic anomalies. Typical DCR sweeping along this track line (taconite pellets and coal) were recovered from both sites during sampling in October 2006 (Figure 3-8). DCR was not present in a similar core taken at a nearby site with no acoustical targets.

FIGURE 3-8
Shallow Core Samples Taken at Duluth Acoustic Anomaly Sample Site

Historic records indicate that there are areas where DCR sweeping rates vary greatly. The sidescan sonar mapping of the lake bottom confirms that there are DCR deposits within shipping lanes. These deposits can be identified as material of higher density than the native soft sediments, but they are not continuous and they do not appear as mounds. The DCR material appears to be concentrated in the shipping lanes, but in several areas (particularly Lakes Michigan and Superior), sonar images indicate DCR is deposited several miles outside of the navigational chart shipping lanes.

3.3.3 Water Quality

3.3.3.1 Introduction

As discussed in Chapter 1, water quality in the waters of the United States was recognized as a national priority by passage of the original CWA in the early 1970s. The Act, as amended in 1987 by the Water Quality Act, includes several sections that could relate to aspects of DCR on the Great Lakes. These include Sections 303 and 304, which call for EPA to develop Water Quality Criteria and the states to promulgate Water Quality Standards for the protection of surface waters. Sections 301, 302, and 402 of the CWA address discharges to waters of the United States and Section 404 regulates the discharge of solids to surface waters.

In addition to national water quality laws, the GLWQA, first signed in 1972 by the United States and Canada, and renewed in 1978, specifically establishes water quality regulations (Annex 1) with the goal to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin ecosystem. The GLWQA, Article VI(1)(f) and Annex 5 requires the United States and Canada to develop measures for control of discharges of vessel wastes.

The CWA and other regulations provide useful information in evaluating potential water quality impacts from DCR sweeping . Water quality chemical limits establish a concentration above which adverse effects to aquatic life or other uses of the surface waters could occur. These limits are used in Chapter 4 to determine if the sweeping of DCR could adversely affect the aquatic resources.

The water quality of the Great Lakes is affected by in-lake cycles, external inputs from watershed inflows, and atmospheric deposition, all of which can be influenced by human activities. Human activities provide much of the input through wastewater discharges, energy production, chemical spills, road salt usage, and other sources. DCR is swept directly to the waters of the Great Lakes and therefore can affect the water quality. Any addition of contaminants to the water from DCR is added to what already exists. Thus, an understanding of the existing water quality is necessary to evaluate the effects of DCR sweeping.

3.3.3.2 Great Lakes Water Quality–Related Stresses and Issues

The State of the Lakes Ecosystem Conference (SOLEC) reviewed the state of the Great Lakes after the 2004 conference and produced a summary of the main stressors on each of the Great Lakes, on Lake St. Clair, and on the St. Lawrence River. A review of SOLEC's Lake stressors indicates that most of the ecological stress on the Great Lakes (for example, contaminant sources, wetland loss, shoreline development, and stormwater runoff) is concentrated along coastal areas and therefore not representative of water quality issues associated with open lake areas. Atmospheric pollution enters all of the lakes with inputs that increase with increased lake surface area. The major stressors that are most relevant to water quality are described below for each lake (SOLEC, 2005).

Lake Superior

Major stressors to the Lake's water quality are chemical contamination, shoreline development, and wetland loss and degradation.

Lake Superior has seen a decline in the toxic organic contaminants in water by 50 percent from 1986 to 1997. Some contaminants, such as dieldrin, mercury, PCBs, and toxaphene, still exceed water quality standards for the Lake. Most of these contaminants enter the Lake through atmospheric deposition. Of concern is chemical contamination, which impairs drinking water for the surrounding communities and contaminates fish, which may be harmful to eat, especially to children and women of childbearing age.

Shoreline development, especially of recreational homes, has increased over the years and is linked to loss of wetlands. The decrease in natural shoreline decreases the amount of natural wetlands, prairies, and forested areas along the shores. These natural buffers act as filters to reduce the amount of contaminated stormwater runoff from urban and agricultural areas. Without these filters, more contaminants are able to directly enter Lake Superior (SOLEC, 2005).

Lake Michigan

A major stressor to Lake Michigan's water quality is habitat alteration. Its habitat has been altered by increased shoreline degradation. Over the last two centuries, more than 60 percent of Lake Michigan's coast and wetlands have been destroyed. The loss of natural shoreline has increased the amount of urban and agricultural stormwater runoff that enters the Lake, altered the watershed hydrology, increased the water and ambient air temperature, and reduced open space (SOLEC, 2005).

Lake Huron

Major stressors to the Lake's water quality are chemical contamination and poor coastal health.

Lake Huron receives chemical contamination from industrial and municipal discharges, land runoff, and atmospheric deposition. Contaminated sediments further contribute to the overall contamination of the Lake. The overall contaminant levels have decreased substantially in fish and wildlife since the 1970s, and the populations of fish-eating birds have increased, although some fish consumption advisories remain.

Water quality testing along the shoreline has found elevated levels of *E. coli* bacteria at many beaches and public areas. Furthermore, outbreaks of Type-E botulism bacterium have killed thousands of fish and water birds in Lake Huron. The sources of these bacteria are currently being investigated (SOLEC, 2005).

Lake Erie

Major stressors to the Lake's water quality are land-use practices, non-native species, nutrient inputs, and chemical and biological contaminants.

Lake Erie is in an area of the United States and Canada that is significantly developed. Urban development and sprawl, intensive agriculture, and construction of shore structures damage the water quality of Lake Erie. The watershed has some areas with over 90 percent of the land in agricultural, urban, and industrial uses. As with other Lakes, land development increases the amount of contaminated stormwater runoff that enters the Lake, alters hydrology of the watershed, and degrades natural habitats.

Zebra mussels (*Dreissena polymorpha*), introduced to Lake Erie in the 1980s, have altered food web dynamics, habitats, and the cycling of nutrients and contaminants in the ecosystem. Along with nutrient controls, the expansion of zebra mussels (which feed by straining suspended matter and food particles from water), has resulted in decreased turbidity in Lake Erie. The increase in water transparency, in turn, has reduced habitat for walleye and, along with lower lake levels, has increased the amount of submerged aquatic plants. The introduction of quagga mussels (*Dreissena bugensis*) has produced similar adverse effects on Lake Erie.

Although there have been nutrient reductions over the past two decades, phosphorus from point and nonpoint sources still affects the water quality in Lake Erie. Phosphorus in the Lake causes increases in algal blooms, changes in aquatic community structures, and reduced use of beaches. Nitrate contamination also is a concern for the same reasons.

Toxic contaminants enter Lake Erie through point and nonpoint sources, the Detroit River system, and long-range atmospheric transport and deposition from regional and global sources. These toxic contaminants affect the water quality of Lake Erie, which affects drinking water, fish, wildlife, and recreational resources. The deaths of fish, fish-eating birds, and mudpuppies in the eastern basin of Lake Erie may be due to biological contaminants such as Type-E botulism bacterium. Control of point and nonpoint sources of chemical and biological contaminants has improved the existing situation. Continued management of legacy contaminants in sediments and landfills, as well as actions to reduce atmospheric pollutant transport, is required to meet contaminant-related objectives (SOLEC, 2005).

Lake Ontario

Major stressors to the Lake's water quality are non-native invasive species, contamination, and urbanization.

As in other Lakes, such as Lake Erie, the introduction of non-native species has substantially affected the water quality of Lake Ontario. Zebra and quagga mussels and the round goby have altered the physical, chemical, and biological characteristics of Lake Ontario. Round gobies eat zebra and quagga mussels and then are themselves eaten by other fish. The mussels and round goby are both suspected of being the cause of Type-E botulism, which has been detected along the Lake Ontario shoreline.

Reduction or elimination of several contaminants over the past few decades has reduced the overall contamination in Lake Ontario. Although there are still contaminants entering Lake Ontario from upstream sources and the atmosphere, there have been drastic improvements in fish and wildlife populations. The level of some contaminants in some fish remains higher than exceedance consumption guidelines for humans, despite the large declines in contamination.

Many communities around Lake Ontario continue to grow. This growth increases the urban sprawl, which increases the amount of paved area in the Lake Ontario watershed. This, in turn, increases the amount of stormwater runoff and transportation-related emissions entering the Lake (SOLEC, 2005).

Water Quality Trends

GLNPO monitors Great Lakes ecosystem indicators. These monitoring activities contribute to an understanding of Great Lakes water quality trends, described below.

Chloride Trends

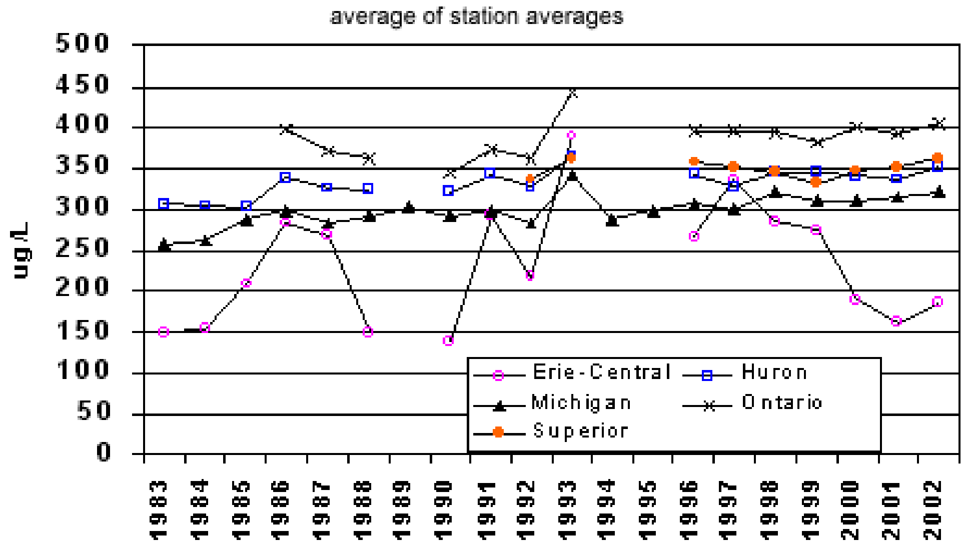
Chloride from human sources has increased chloride concentrations in the Great Lakes. Lake Ontario has the highest chloride concentration, which is less than 25 mg/L, and Lake Superior has the lowest concentration, of less than 5 mg/L. For comparison, public drinking water secondary standards require chloride levels not to exceed 250 mg/L for aesthetic taste and odor concerns (EPA, 1992). While recent trends indicate a decrease in chloride concentration over the last 20 years in Lake Ontario and Lake Erie, long-term models predict increasing chloride ion concentrations in all the lakes over the next 500 years.

Nutrient Enrichment Trends

Nutrient enrichment can lead to excessive growth of aquatic plants and algae. Overgrowth of aquatic plants can alter aquatic habitat, reduce dissolved oxygen, and cause foul odors and taste.

Nitrate and Nitrite. Nitrate and nitrite concentrations continue to increase in the Great Lakes. Nitrate and nitrite are nutrients that can come from fertilizer runoff, raw or treated sewage discharges, or erosion of natural soils. The long-term trends in concentration are shown in Figure 3-9.

FIGURE 3-9
Spring Nitrate and Nitrite Concentration Trends by Lake



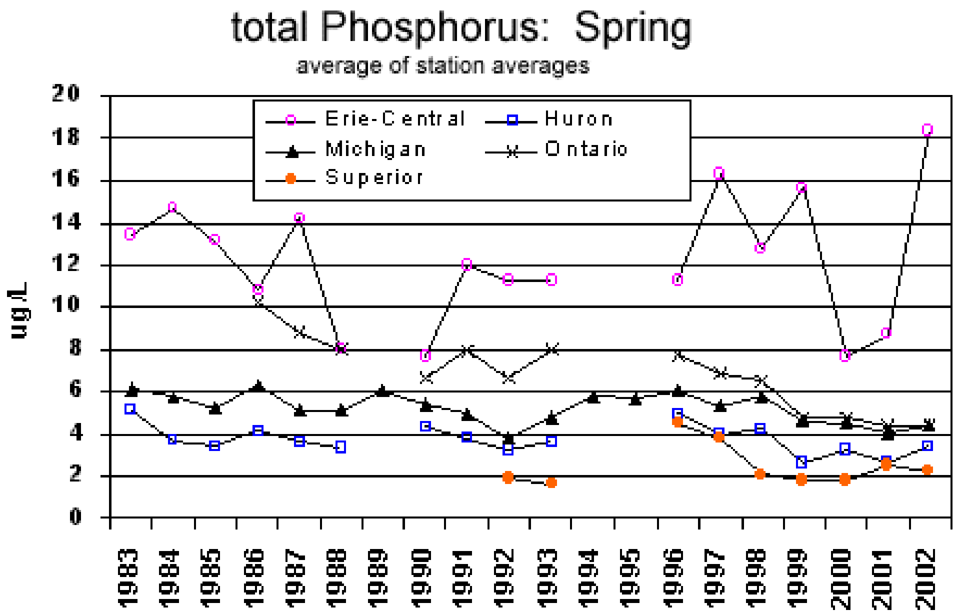
Source: EPA, 2003.

Reactive Silica. Rocks contain silica, which can become dissolved and bioavailable because of weathering. The largest input of dissolved reactive silica to the Great Lakes is from rivers, which carry silica dissolved from rocks. Dissolved reactive silica is a building block for diatoms, a class of organisms and a type of phytoplankton at the bottom of the food web. Concentrations have increased substantially in Lake Michigan and in the eastern basin of Lake Erie while remaining stable in the other Great Lakes.

Phytoplankton. Lake Erie has seen a change in the phytoplankton community. Species associated with eutrophic conditions have been supplanted by species associated with mesotrophic conditions, signifying a decrease in the nutrient enrichment of the lake. Substantial reductions of summer phytoplankton populations occurred in the early 1990s in the western basin of Lake Erie. The timing of this trend suggests the possible impact of zebra mussels. No trends are apparent for Lakes Huron, Ontario, and Michigan. Only 3 years of data are available for Lake Superior.

Phosphorus. Concentrations of phosphorus have stabilized in all lakes except Lake Ontario, where total phosphorus is slowly decreasing. The concentrations of total phosphorus are below standards set by the United States and Canada in all the Great Lakes except Lake Erie. Lake Erie's western basin exceeds the target concentration by about 60 percent, whereas both the central and eastern basins of Lake Erie exceed their target concentrations by about 10 to 20 percent. The long-term concentration trends are shown in Figure 3-10.

FIGURE 3-10
Spring Total Phosphorous Concentration Trends by Lake



Source: EPA, 2003.

Although phosphorus occurs naturally, the historical problems caused by elevated levels have originated from anthropogenic sources. Detergents, sewage treatment plant effluent, and agricultural and industrial sources have historically introduced large amounts of phosphorus to the lakes (EPA, 2006). Phosphorus has been found to be a limiting factor on primary food web production in all of the Great Lakes (Guildford et al., 2003).

Chlorophyll *a*. Chlorophyll *a* is a surrogate measure for algal growth and the relative amount of algal activity in a lake. Concentrations of chlorophyll *a* are stable in all the Great Lakes. Lake Superior has the lowest level and Lake Erie the highest.

Water Clarity. Water clarity is based on the depth to which light can penetrate and decreases with increased concentrations of dissolved substances and suspended particulates. Examples of factors that can affect clarity are lake turnover, algal blooms, watershed characteristics, and precipitation. Water clarity in the lakes was measured by Secchi disc depth, which reflects turbidity levels and provides historical and trend data. Direct measurement of turbidity is not available through historical or trend data. Springtime water clarity has increased (become clearer) in eastern Lake Erie, decreased (become less clear) in Lake Huron, and remained stable in the other lakes. The summer water quality has remained stable in all lakes except Lake Ontario, where the depth of reading more than doubled (became clearer) from pre-1990 to post-1990 readings.

Zebra mussels were first recorded in the Great Lakes in the late 1980s, and as filter feeders they remove substantial amounts of phytoplankton and suspended particulates from the water (Benson and Raikow, 2007). Mussels have increased Lake Erie's clarity by up to 600 percent (University of Wisconsin Sea Grant Institute, 2001).

Dissolved Oxygen Trends

Oxygen depletion is a persistent problem in the central basin of Lake Erie. Dissolved oxygen concentrations are very low at some locations and depths, with the worst conditions in August through September. The duration of oxygen depletion in Lake Erie is shorter than in the mid-1980s. However, dissolved oxygen concentrations in Lake Erie are still depleted to stressful levels (less than 4 mg/L) during late summer.

3.3.3.3 Additional Water Chemistry Parameters

Background information for chemical parameters in the Great Lakes is included in Tables 3-8 and 3-9.

Trace Metals

Factors that affect the distribution of trace metals include water depth, season, suspended particulate abundance, and biological processes. Higher concentrations generally are found in nearshore locations and especially near urban centers and polluted river mouths. Nriagu (1996) provided baseline levels for trace metals found in Lakes Ontario, Erie, and Superior. This study collected samples throughout the water column, some as deep as 1 m (3.28 feet) above the lake bottom. Rossmann and Barres (1988) provided median values for metals concentrations at a depth of 1 m for Lakes Huron and Michigan. The data are presented in Table 3-8.

TABLE 3-8
Metals Concentrations in the Great Lakes

	Water Quality Criteria						
Metal	**Acute**	**Chronic**	**Ontario**	**Erie**	**Huron**[a]	**Michigan**[a]	**Superior**
Aluminum (µg/L)	750	87	20–180[b]	NA	3.1	7.8	NA
Arsenic (µg/L)	340	148	NA	NA	0.7	0.79	NA
Cadmium (ng/L)	4,517	2,462	0.5–11.4	0.6–9.2	41	45	NA
Chromium (ng/L)	16,293	11,435	239–495	56–216	110	680	26–97
Copper (ng/L)	13,999	9,329	540–1,098	703–1,061	280	320	629–834
Iron (ng/L)	NA	1,000,000	28–4,087	120–5,048	800	2,500	36–1,524
Lead (ng/L)	81,645	3,182	5.4–21	1.3–32	8.9	140	0.3–25
Manganese (ng/L)	NA	NA	8–449	NA	280	150	5–327
Nickel (ng/L)	469,174	52,163	467–1,023	606–1,542	490	640	112[c]
Selenium (ng/L)	23,986	5,000	NA	NA	480	150	NA
Zinc (ng/L)	119,816	119,816	56–331	20–377	170	480	144–867

Note: NA, not available. Default hardness levels were used for criteria that are hardness dependent. All concentrations are based on unfiltered levels.
Sources: Water quality criteria: Great Lakes Initiative (GLI) Criteria (EPA, 1995) or National Ambient Water Quality Criteria (EPA, 2006) if GLI was not available. Metals concentrations: Nriagu et al. (1996) unless noted otherwise.
[a]Data reported for Lakes Huron and Michigan (Rossmann and Barres, 1988).
[b]Bay of Quinte, Lake Ontario (Poulton, 1992).
[c]Field and Sherrell, 2003.

The only metals criterion that was exceeded in the Great Lakes was that for aluminum, which is listed as a nonpriority pollutant by EPA with a chronic water quality criterion of 87 µg/L. Some samples collected in the Bay of Quinte, in Lake Ontario, exceeded this criterion (Poulton, 1992).

Polycyclic Aromatic Hydrocarbons

Atmospheric deposition of persistent organic pollutants, such as PAHs, has affected the Great Lakes water quality and fisheries. Large urban and industrial areas are a major source of these pollutants. Although PAH human health criteria for the consumption of water and organisms were not exceeded, studies have shown that elevated atmospheric concentrations of PAHs in the greater Chicago area enhance loadings to southern Lake Michigan. Table 3-9 summarizes concentrations of PAHs found in the Great Lakes (Offenberg and Baker, 2000).

TABLE 3-9
Polycyclic Aromatic Hydrocarbons Concentrations in the Great Lakes

PAH	Water Quality Criteria		Ontario	Erie[a]	Huron	Michigan[b]	Superior[c]
	Acute	Chronic					
Total PAHs (ng/L)	NA	NA	NA	10	NA	13.9	6.3
Anthracene (ng/L)	13,000	730	NA	NA	NA	0.1	0
Benzo(a)anthracene (ng/L)	490	27	NA	NA	NA	0.2	0.5
Benzo(a)pyrene (ng/L)	240[d]	14[d]	NA	0.3	NA	0.3	0.5
Chrysene (ng/L)	240[d]	14[d]	NA	NA	NA	0.3	0.4
Dibenz(a,h)anthracene(ng/L)	240[d]	14[d]	NA	NA	NA	0.25	0.1
Fluoranthene (ng/L)	33,600	6,160	NA	NA	NA	1.4	0.3
Fluorene (ng/L)	70,000	3,900	NA	NA	NA	2	0.4
Naphthalene (ng/L)	190,000	12,000	NA	NA	NA	NA	NA
Phenanthrene (ng/L)	30,000	6,300	NA	NA	NA	2.8	3.3
Pyrene (ng/L)	240	14	NA	NA	NA	0.6	0.4

Note: NA, data not available.
Source: Water quality criteria: Suter and Tsao, 1996.
[a]Kelly et al., 1991.
[b]Southern Lake Michigan (Offenberg and Baker, 2000).
[c]Baker and Eisenreich, 1989.
[d]The criterion for benzo(a)pyrene is used as a surrogate for individual PAH compounds where a criterion was not available.

Calcium

Calcium concentrations in the Great Lakes are presented in Table 3-10. Calcium levels can be a limiting factor in mussel populations. Although adult zebra mussels can tolerate low-calcium waters, veligers (juvenile mussels) are most successfully reared in water with calcium concentrations ranging from 44 to 50 mg/L. The minimum calcium concentration necessary for zebra mussel survival ranges from 12 to 24 mg/L (Sprung, 1987; Ram and Walker, 1993). Quagga mussel veligers may prefer slightly higher calcium levels (Sprung, 1987; Jones and Ricciardi, 2005). Because veligers are highly sensitive to calcium, the calcium concentration of a water body is a critical factor in the establishment of *Dreissena* populations. Based on this information, it appears that calcium is not limiting Dreissenid mussel density or distribution in Lakes Ontario, Erie, or Michigan. Calcium is likely limiting in Lake Superior, and although data are not available for Lake Huron, since much of the water in Lake Huron comes from Lake Superior, calcium may be a limiting factor for mussels in Lake Huron.

TABLE 3-10
Calcium Concentrations in the Great Lakes

	Ontario[a]	Erie[a]	Huron	Michigan[b]	Superior[c]
Average (mg/L)	35.7	35.7	NA	33 (offshore), 35 (nearshore)	14.3
Range (mg/L)	32.5–38.9[d]	34.2–37.2[d]	NA	17–40	13.8–14.8[d]

Note: NA, not available.
[a] Hincks and Mackie, 1997.
[b] Torrey, 1976.
[c] Faure et al., 1967.
[d] Range calculated based on standard deviation.

3.3.3.4 Trophic State of the Great Lakes

The trophic state of a lake is a classification system indicating the relative clarity and biological activity occurring in a lake. DCR sweepings have the potential to affect the trophic state if they add substantial nutrients and stimulate algal growth. At one end of the continuum are oligotrophic lakes, which have cool, clear, low-nutrient characteristics. At the other end of the continuum are eutrophic lakes, which are characterized as warm, cloudy, and having high levels of nutrients and low levels of dissolved oxygen.

A trophic index is used to measure the trophic state of each of the Great Lakes. Table 3-11 contains the trophic goal for each lake (EPA, 2006). All lakes are meeting their goals; however, the low dissolved oxygen levels in the central basin of Lake Erie present a management challenge for the lake continuing to meet its trophic goal (EPA, 2006).

TABLE 3-11
Trophic Goals for the Great Lakes

Lakes	Trophic Goal	Trophic Characteristics
Superior, Michigan, Huron, Lake Erie eastern basin	Oligotrophic	Lakes that are typically cool and clear, and have relatively low nutrient concentrations.
Ontario, Lake Erie central basin	Oligomesotrophic	The trophic state with both mesotrophic and oligotrophic characteristics.
Lake Erie western basin	Mesotrophic	The trophic state of a lake that falls along the continuum between oligotrophic and eutrophic.
None	Eutrophic	The most productive state of a lake, characterized by high nutrient concentrations, which result in algal growth, cloudy water, and low dissolved oxygen levels.

Source: EPA, 2006.

3.3.4 Biological and Related Resources

Biological resources consist of plants and animals and their habitats. These biological resources are intrinsically valuable, but they also provide essential aesthetic, recreational, and socioeconomic benefits. The integrity of biological resources depends on the continued presence of sensitive resources that may be particularly susceptible to environmental stresses, suitable sediment and water quality to support biological resources, and the potential for contaminants to accumulate in the food web. This section focuses on the resources that are susceptible to change from sweeping of DCR sweepings, are important to the function of the ecosystem, are of special societal importance, or are protected under Federal or State law or statute.

3.3.4.1 Special-Status (Threatened and Endangered) Species

Under the Endangered Species Act (1973), threatened and endangered species and the ecosystems they depend on to survive are conserved and protected. "Endangered" means that a species is in danger of extinction in the near future throughout all or most of its range. A "threatened" plant or animal species is likely to become endangered if it is not protected. Among other responsibilities, the U.S. Fish and Wildlife Service and National Marine Fisheries Service are charged with creating and maintaining a national list of endangered and threatened species and enforcing protection for listed species. Most states have programs similar to the Federal one. Since even small effects to a few individuals of such species can affect the entire population, both regulations and sound science dictate that potential interaction between DCR sweeping and these species be examined as part of the NEPA process. Eleven species of state-listed threatened or endangered fish exist in the Great Lakes (Table 3-12), but no federally threatened or endangered species exist (USFWS, 2007).

TABLE 3-12
State-Listed Threatened or Endangered Fish Species Found in the Great Lakes

State	Common Name	Taxonomic Name	Lakes Where Present	Status
New York	Silver chub	*Macrhybopsis storeriana*	Erie	Endangered
	Lake sturgeon	*Acipenser fulvescens*	Ontario, Erie	Threatened
	Mooneye	*Hiodon tergisus*	Erie	Threatened
	Lake chubsucker	*Erimyzon sucetta*	Erie	Threatened
	Round whitefish	*Prosopium cylindraceum*	Ontario	Endangered
Michigan	Lake sturgeon	*Acipenser fulvescens*	Huron, Michigan, Erie, Superior	Threatened
	Lake herring	*Coregonus artedi*	Huron, Michigan, Erie, Superior	Threatened
	Shortjaw cisco	*Coregonus zenithicus*	Huron, Michigan, Superior	Threatened
	Sauger	*Sander canadensis*	Huron, Michigan, Erie	Threatened
	Mooneye	*Hiodon tergisus*	Erie	Threatened
Illinois	Lake sturgeon	*Acipenser fulvescens*	Michigan	Threatened
	Longnose sucker	*Catostomus catostomus*	Michigan	Threatened
	Lake herring	*Coregonus artedi*	Michigan	Threatened
Indiana	Lake sturgeon	*Acipenser fulvescens*	Michigan	Endangered
Ohio	Lake sturgeon	*Acipenser fulvescens*	Erie	Endangered
	Spotted gar	*Lepisosteus oculatus*	Erie	Endangered
	Lake herring	*Coregonus artedi*	Erie	Endangered
	Longnose sucker	*Catostomus catostomus*	Erie	Endangered

TABLE 3-12
State-Listed Threatened or Endangered Fish Species Found in the Great Lakes

State	Common Name	Taxonomic Name	Lakes Where Present	Status
Pennsylvania	Lake sturgeon	*Acipenser fulvescens*	Erie	Endangered
	Longnose sucker	*Catostomus catostomus*	Erie	Endangered
	Burbot	*Lota lota*	Erie	Threatened
Minnesota	N/A			
Wisconsin	N/A			

Source: USFWS, 2007.

Most species spawn in tributaries or protected waters of the lakes. Only a handful of fish species in the Great Lakes use deep offshore waters for spawning. These include lake trout, lake herring (Lakes Superior and Ontario only), several species of cisco (some of which are now believed to be extinct), fourhorn sculpin, slimy sculpin (Lake Ontario only), and the emerald shiner (Lake Erie only). The shortjaw cisco and lake herring are the only threatened or endangered species that are known to spawn in deep offshore waters of the Great Lakes.

Most of the fish species at risk in Canadian waters (Table 3-13) are associated with protected shallow waters.

Lake chubsucker, spotted gar, and sauger generally are associated with rivers or littoral lake areas. Lake sturgeon and mooneye generally are found in the Great Lakes at depths less than 10 meters. The silver chub larva has been found at depths of 18 to 20 meters in Lake Erie. The round whitefish is most common in Lake Michigan at depths of 7 to 22 meters and in Lake Superior at depths less than 37 meters, though these fish have been found at greater depths. The longnose sucker is most common at depths of 24 to 37 meters and is seldom found at depths greater than 55 meters. The shortjaw cisco formerly inhabited intermediate depths in deep water areas of Lake Michigan, but may have been extirpated in Lake Michigan. The shortjaw cisco is now found only in Lake Superior and is found along all shores of Lake Superior at depths ranging from 55 to 126 meters. Lake herring are frequently associated with inshore shoals and shallow water and are most common at depths of 18 to 53 meters in Lake Superior (Becker, 1983). Burbot have been seen in large numbers at depths of 18 to 36 meters and as deep as 210 meters.

TABLE 3-13
Canadian Listed Fish Species at Risk in Great Lakes Drainage Basin

Classification	Fish Species
Endangered	Northern madtom *(Noturus stigmosus)*
	Pugnose shiner *(Notropis anogenus)*
	Redside dace *(Clinostomus elongatus)*
	Shortnose cisco *(Coregonus reighardi)*
Threatened	Black redhorse *(Moxostoma duquesnei)*
	Channel darter *(Percina copelandi)*
	Eastern sand darter *(Ammocrypta pellucida)*
	Lake chubsucker *(Erimyzon sucetta)*
	Lake sturgeon *(Acipenser fulvescens)* (Great Lakes–Upper St. Lawrence populations)
	Shortjaw cisco *(Coregonus zenithicus)*
	Spotted gar *(Lepisosteus oculatus)*
	Cutlip minnow *(Exoglossum maxillingua)*
Special Concern	American eel *(Anguilla rostrata)*
	Bigmouth buffalo *(Ictiobus cyprinellus)*
	Blackstripe topminnow *(Fundulus notatus)*
	Bridle shiner *(Notropis bifrenatus)*
	Deepwater sculpin *(Myoxocephalus thompsonii)* (Great Lakes–Western St. Lawrence populations)
	Grass pickerel *(Esox americanus vermiculatus)*
	Northern brook lamprey *(Ichthyomyzon fossor)* (Great Lakes–Upper St. Lawrence populations)
	Orangespotted sunfish *(Lepomis humilis)*
	Pugnose minnow *(Opsopoeodus emiliae)*
	River redhorse *(Moxostoma carinatum)*
	Silver chub *(Macrhybopsis storeriana)*
	Silver shiner *(Notropis photogenis)*
	Spotted sucker *(Minytrema melanops)*
	Upper Great Lakes kiyi *(Coregonus kiyi kiyi)*
	Warmouth *(Lepomis gulosus)*

Source: Environment Canada, 2007a.

3.3.4.2 Protected and Sensitive Areas

There are two types of protected and sensitive areas throughout the Great Lakes. There are a number of areas designated for protection or management by state or federal agencies and there are areas identified as sensitive habitat during a multi-agency and stakeholder workshop on management of DCR (Reid and Meadows, 1999). Descriptions for those areas not previously identified in the workshop have been compiled from agency and other relevant web sites. The letters in this section correspond with Figure 3-11.

Designated or Managed Areas

Lake Superior

(A) Isle Royale National Park—Under the exclusive jurisdiction of the U.S. National Park Service, the park is located in the northwestern section of Lake Superior, within 14 miles of the Ontario (Canada) shoreline, 20 miles of Minnesota, and approximately 45 miles from Michigan's Upper Peninsula. Ninety-nine percent of the land area of the park is designated Federal wilderness. The park boundary extends 4.5 miles out into Lake Superior from the outermost land areas of the park. The designation ensures that the park will remain mostly undeveloped. The park encompasses a total area of 850 square miles. (West Bounding Coordinate 89° 7.5'W, East Bounding Coordinate 88° 24'W, North Bounding Coordinate 48° 12'N, South Bounding Coordinate 47° 48'N).

(B) Apostle Islands National Lake Shore—Created under the jurisdiction of the U.S. National Park Service, the park is on the tip of the Bayfield Peninsula in northern Wisconsin, including 21 islands in Lake Superior and a 12-mile narrow strip of mainland shoreline. The park encompasses 69,372 acres, of which 27,323 acres are submerged lands in Lake Superior; the park boundary extends a quarter mile from the shore of the mainland and from each island. (46° 57'N 90° 53'W).

(C) Whittlesey Creek National Wildlife Refuge (NWR)—Created under the jurisdiction of the U.S. Fish and Wildlife Service, this refuge is part of a large wetland complex on Lake Superior, near Ashland, Wisconsin. Its purpose is to protect, restore, and manage the lower portion of Whittlesey Creek and coastal wetlands along the lakeshore of Chequamegon Bay. Up to 540 acres of coastal wetland in the Whittlesey Creek watershed will be acquired, and up to 1,260 acres will be protected through conservation easements. (46° 33.1'N 91° 7.2'W).

(D) Huron National Wildlife Refuge (NWR)—Under the jurisdiction of the U.S. Fish and Wildlife Service, these eight islands have the designation of a Wilderness Area. The refuge was established for the protection of migratory birds, specifically, a large nesting colony of herring gulls. It is an unstaffed refuge managed by the Seney National Wildlife Refuge. Only West Huron Island (Lighthouse Island) is open to the public, during daylight hours, for hiking and nature study. All remaining islands are closed to the public. The refuge is 147 acres and is located about three miles from the coast. (Lighthouse Island 46° 57.8'N 87° 59.9'W).

(E) Pictured Rocks National Lake Shore—Created under the jurisdiction of the U.S. National Park Service, this site is located along the central upper peninsula of Michigan, on the south-central shore of Lake Superior. Pictured Rocks encompasses 71,397 acres of land including 42 miles of Lake Superior shoreline. The Lakeshore has jurisdiction over ¼ mile of surface water. (Au Sable Point 46°40.3'N 86° 8.4'W).

Lake Michigan

(F) Michigan Islands National Wildlife Refuge (NWR)—Created under the jurisdiction of the U.S. Fish and Wildlife Service, this unstaffed refuge is comprised of eight islands in Lakes Michigan and Huron. Thunder Bay and Scarecrow islands in Thunder Bay (near Alpena, MI), and Big and Little Charity Islands in Saginaw Bay are managed by Shiawassee National Wildlife Refuge in Saginaw, MI. Seney National Wildlife Refuge

(NWR) has management responsibility for Gull, Pismire, Hat, and Shoe Islands, part of the Beaver Island Group in the northern portion of Lake Michigan. Scarecrow, Pismire, and Shoe Islands are officially designated as Michigan Islands Wilderness Area (12 acres total). The refuge was created to protect breeding grounds for migratory birds and other wildlife. (Gull Island 45° 42.1′N 85° 50.2′W).

(G) Sleeping Bear Dunes National Lakeshore—Created under the jurisdiction of U.S. National Park Service, the park is located in northern Michigan on the Leelanau Peninsula. The park stretches along 35 miles of Lake Michigan's eastern coastline, and includes North and South Manitou Islands. It encompasses 111 square miles and 64 total miles of coastline. (44° 43.5′N 86° 5.1′W).

(H) Indiana Dunes National Lakeshore—Created under the jurisdiction of the U.S. National Park Service, the park spans 15 miles of Lake Michigan shoreline between Michigan City and Gary, IN. The national lakeshore's jurisdiction extends 300 feet off the shore of Lake Michigan, except for the area in and next to Indiana Dunes State Park. The park currently includes 15,060 acres. (41° 38.5′N 87° 2.5′W).

(I) Milwaukee Mid-Lake Protection Area—This area is defined in the IEP.

(J) Northern Refuge, shallow reefs near Beaver Island—This area is broadly discussed in the IEP. Specifically, it is one of two areas (along with the Southern Refuge, Mid-Lake Reef Complex, that corresponds with the Milwaukee Mid-Lake Protection Area listed above) protected for restoration for Lake Michigan lake trout, where lake trout historically spawned. In the refuges, trout are protected from fishing, and invasive species are less abundant.

Lake Huron

(K) Harbor Island National Wildlife Refuge (NWR)—Created under the jurisdiction of the U.S. Fish and Wildlife Service, the refuge is located just off the northwest shore of Drummond Island in Potagannissing Bay on Lake Huron. The 695-acre, horseshoe-shaped island hosts a variety of habitats and wildlife. The refuge is managed by staff at Seney NWR, in Seney, Michigan. (46° 03′N 83° 46′W).

(L) Thunder Bay NMS - Designated by the National Oceanic and Atmospheric Administration (NOAA), the sanctuary protects a nationally significant collection of shipwrecks and other maritime heritage resources. It encompasses 448 square miles of northwest Lake Huron, off the northeast coast of Michigan's Lower Peninsula. The landward boundary of the sanctuary is marked by the northern and southern limits of Alpena County, and the sanctuary extends east from the lakeshore to longitude 83 degrees west.

Lake Erie

(M) Detroit River National Wildlife Refuge (NWR)—Created under the jurisdiction of the U.S. Fish and Wildlife Service, the refuge includes islands, coastal wetlands, shoals, and waterfront lands along 48 miles of the Detroit River and Western Lake Erie shoreline. The refuge currently encompasses 4,982 acres. (Grassy Island 42° 13.6′N 83° 81′W)

(N) Cedar Point National Wildlife Refuge (NWR)—This refuge was donated to the U.S. Fish and Wildlife Service and provides stopover status for migratory birds. Currently, the refuge consists of 2,445 acres of marsh, divided into three pools. The only public access is a fishing area open from June through August. The refuge is managed by staff at Ottawa National Wildlife Refuge, in Oak Harbor. (Latitude: 41° 41.2'N Longitude: -83° 19.3'W).

(O) Ottawa National Wildlife Refuge (NWR)—The refuge was established under the jurisdiction of the U.S. Fish and Wildlife Service to preserve resting habitat for migrating birds. The staff at the refuge also manages Cedar Point and West Sister Island refuges. The complex is located 15 miles east of Toledo, Ohio. The three refuges together now include approximately 9,000 acres of habitat and some of the last remnants of the "Great Black Swamp" in the heart of the Lake Erie marshes. (Latitude 41° 37'N, 83° 13'W)

(P) West Sister Island National Wildlife Refuge (NWR)—The refuge is jointly owned by the U.S. Coast Guard and U.S. Fish and Wildlife Service. It is located in the western basin of Lake Erie. It is designated as a Federal wilderness area and is managed by the staff at the Ottawa NWR. The refuge is managed to provide nesting habitat for the largest heron/egret rookery in the U.S. Great Lakes. (41° 44.4'N 83° 6.3'W).

(Q) Old Woman Creek National Estuarine Research Reserve - The reserve was designated and is managed as a cooperative partnership between the Ohio Department of Natural Resources (ODNR) and the National Oceanic and Atmospheric Administration (NOAA). The reserve is located on the south-central shore of Lake Erie in Erie County, Ohio, three miles east of Huron. The total acreage is 571. (North Bounding Coordinate 41° 23'N, South Bounding Coordinate 41° 22'N, East Bounding Coordinate 82° 30.4'W, West Bounding Coordinate 82° 31'W).

Other Sensitive Habitats

Lake Superior

(R) Caribou Island and Southwest Protection Area—This area includes fish spawning and nursery grounds. It was identified in the workshop on management of DCR and defined in the IEP.

(S) Stannard Rock Protection Area—This is an offshore fish spawning reef. This area was identified in the workshop on management of DCR and defined in the IEP.

(T) Superior Shoal Protection Area—This is an offshore fish spawning reef. This area was identified in the workshop on management of DCR and defined in the IEP.

Lake Michigan

(U) Waukegan Protection Area—This area is defined in the IEP.

(V) Green Bay—This area is known to be eutrophic or mesotrophic with restricted circulation. It also includes sensitive fish habitats associated with Whalback, Minneapolis, and Drisco Shoals and bordering islands. Green Bay is identified and discussed in the workshop on management of DCR and the IEP.

Lake Huron

(W) Saginaw Bay—This area is known to be eutrophic or mesotrophic with restricted circulation. It was identified and discussed in the workshop on management of DCR and the IEP.

(X) Six Fathom Scarp Mid-Lake Protection Area—This area is defined in the IEP.

Lake Erie

(Y) Western Basin—This area includes highly productive and sensitive habitats associated with islands and reefs. It is known to be eutrophic or mesotrophic with restricted circulation due to shallow and confined conditions. This area was identified in the workshop on management of DCR and defined in the IEP.

3.3.4.3 Benthic Community

A benthic community is an assemblage of organisms susceptible to potential impacts from DCR sweeping because they live in and on lake sediments. DCR sweepings are much denser than water and are quickly deposited and incorporated into sediments where the benthic community resides. Once in the sediments, the DCR sweepings have the potential to alter the physical and chemical nature of the sediments (that is, the habitat for benthic organisms) and thus potentially affect the benthic invertebrate community through changes in the sediment quality and possibly through smothering the community.

Benthic Macroinvertebrate Communities

The benthic community comprises the interacting organisms found at or near the bottom of the Great Lakes and consists of organisms, such as worms, that generally reside in or on the upper portion of lake sediments or that spend a great deal of time in contact with lake sediments. Benthic macroinvertebrate communities of the Great Lakes ecosystem, especially of the deep-water profundal regions, are dominated by a few species of organisms (Lozano et al., 2001). In general, community structure consists of organisms in the following taxonomic groups: Oligochaeta (worms), Sphaeriidae (clams), and Amphipoda (scuds) (Cook and Johnson, 1974). Several oligochaetes, *Stylodrilus heringianus* and *Limnodrilus hoffmeisteri,* have been found throughout the offshore regions and may account for 10 to 20 percent of the total benthic population density (Mozley and Howmiller, 1977). The density of the bivalve Sphaeriidae can account for 5 to 15 percent of the benthos in waters less than 295 feet (90 meters) deep.

TABLE 3-14
Sensitive Fish Habitat Areas and Other Protected Sensitive Areas

	Erie	Huron	Michigan	Ontario	Superior
National Lake Shore	—	—	Sleeping Bear Dunes National Lake Shore (G) Indiana Dunes National Lake Shore (H)	—	Apostle Islands National Lake Shore (B) Pictured Rocks National Lake Shore (E)
National Wildlife Refuge	Cedar Point National Wildlife Refuge (L) Detroit River National Wildlife Refuge (K) Ottawa National Wildlife Refuge (M) West Sister Island National Wildlife Refuge (N)	Harbor Island National Wildlife Refuge (I) Michigan Islands National Wildlife Refuge (F)	Michigan Islands National Wildlife Refuge (F)	—	Huron National Wildlife Refuge (D) Whittlesey National Wildlife Refuge (C)
National Marine Sanctuary	—	Thunder Bay National Marine Sanctuary (J)	—	—	—
National Park	—	—	—	—	Isle Royale National Park (A)
National Estuarine Research Reserve	Old Woman Creek National Estuarine Research Reserve (O)	—	—	—	—
Sensitive Fish Habitat Areas	Western Basin (W)	Saginaw Bay (U) Six Fathom Scarp Mid-Lake Protection Area (V)	Milwaukee Mid-Lake Protection Area (S) Waukegan Protection Area (T)	—	Caribou Island and Southwest Protection Area (P) Stannard Rock Protection Area (Q) Superior Shoal Protection Area (R)
Critical Habitat for Breeding Populations of Piping Plover (*Charadrius melodus*)[a]	3 habitat areas	5 habitat areas	21 habitat areas	1 habitat area	5 habitat areas

Note: See Figure 3-11 for areas' letter designations. Michigan Islands National Wildlife Refuge is represented under both Lakes Michigan and Huron.
Source: USDOC and USDOI, 2004. Modified from USCG, 2005.
[a] Note that these critical habitat areas are land based.

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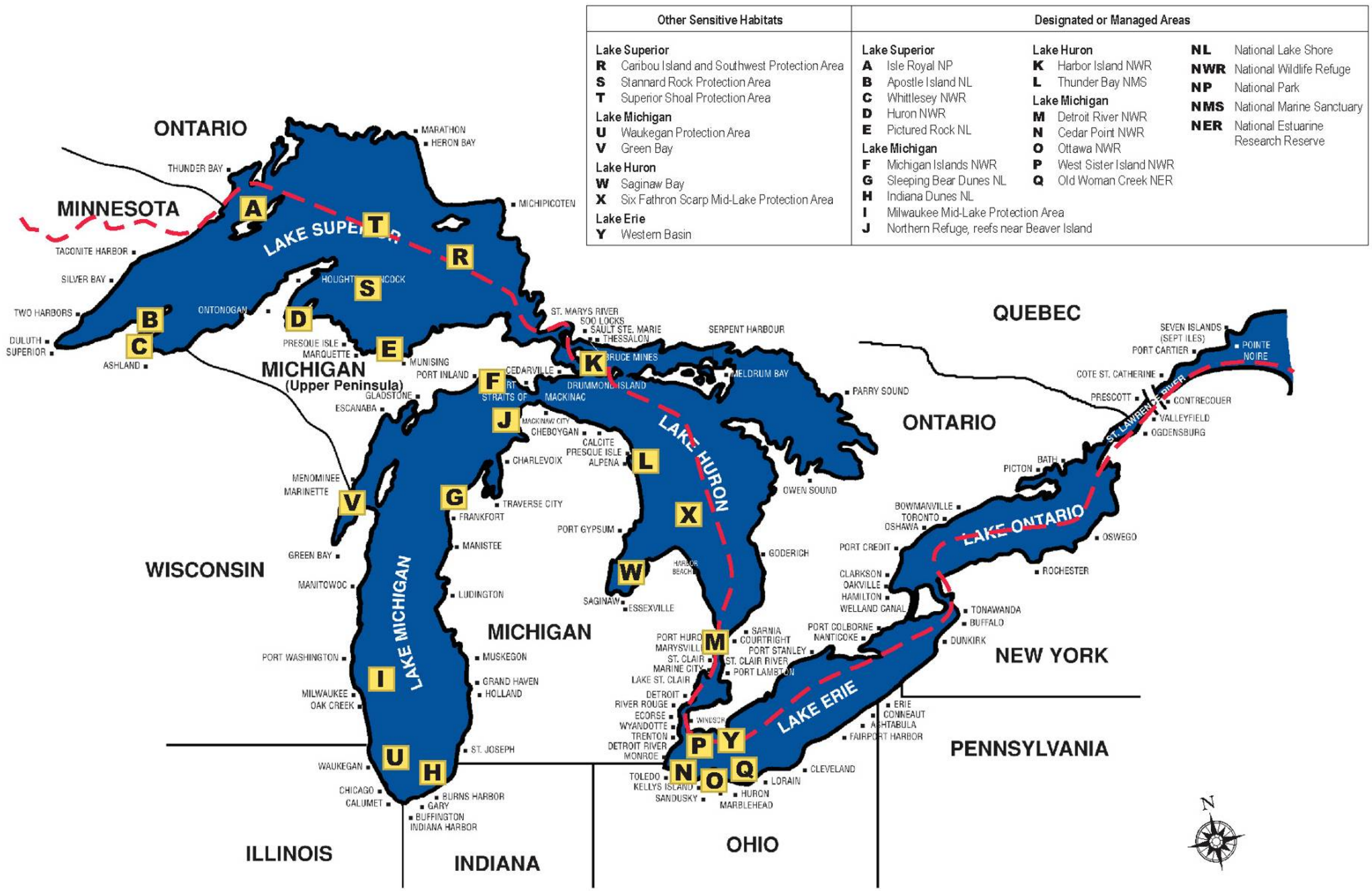

Reference: Lake Carriers' Association (LCA 2004)

Canada-United States International Border

FIGURE 3-11
Protected and Sensitive Areas
U.S. Coast Guard Dry Cargo Sweepings EIS

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Over the last 10 years, benthic invertebrate populations have undergone major changes in nearshore and offshore regions of the Great Lakes. Many of these changes can be attributed to the widespread distribution and great abundances of the invasive dreissenid mussels, the zebra mussel and quagga mussel (Nalepa et al., 1991; International Association for Great Lakes Research, 2002). Benthic invertebrates play a key role in the cycling of energy, nutrients, and contaminants through the food web and are themselves important components of aquatic food webs because they are prey for many fish. As a result, they are often used as indicators of ecosystem health (EPA, 2007c). Therefore, if the benthic invertebrate community is significantly altered, it could alter these processes and ultimately have an ecosystem wide effect.

Benthic Community Structure

Benthic community structure data were collected from the same sediment samples described in Section 3.3.2.3 (five shipping track lines where DCR was found: two in Lake Superior, one in Lake Michigan, and two in Lake Erie), and are described in more detail in Appendix H. It should be noted that interpretation of these benthic community structure data is limited by the small sample size and the potential for seasonal variations, which could affect the measurement and characterization of community structure.

Data collected from Lake Superior indicate that the benthic community structure in DCR sweeping areas is similar to that of the reference areas. Abundance values (the total number of organisms present and total number of organisms present within a specific taxonomic group) were low in DCR sweeping and reference areas but similar to data collected by EPA (2007c). Likewise, taxa richness (the number of taxonomic groups) was low, averaging three to six species per area, but within the range of two to six species per sample location observed by EPA (2007c). The amphipod *Diporeia hoyi*, a sensitive species, was present in reference and DCR sweeping areas.

In Lake Michigan, benthic community measures were higher in abundance of freshwater clams (Family Sphaeriidae) and diversity (the number of taxa present and how evenly the density of organisms is partitioned among the taxa) in the DCR sweeping area relative to the reference area. Benthic community measures were lower when measured by total organism abundance and aquatic worm abundance in the DCR sweeping area relative to the reference area. A comparison to EPA data (2007) suggests that taxa richness is within the previously measured range, but total organism abundance, observed at more than 2,000 organisms per square meter, was higher than that observed in this study (maximum of 759 per square meter). *Diporeia hoyi* also was observed at higher levels (fewer than 1,000 per square meter) by EPA (2007) as compared to this study (none were observed; see following discussion of the species).

In Lake Erie, little difference has been observed in the benthic community measures between the DCR discharge and reference areas. The benthic community structure in Lake Erie is influenced by many factors, such as a large mussel (Family Dreissenidae) population, which can significantly alter the lake bottom, and the eutrophic nature of the system. EPA (2007c) data for Lake Erie indicate high taxa richness (median of 11 taxa), high abundance (fewer than 6,000 organisms per square meter), and no *Diporeia* spp.; where the amphipod was absent, aquatic worms were dominant. The results of this investigation in track line areas and reference areas are consistent with EPA findings.

Maher (1999) also performed an extensive evaluation of benthic community structure in Lake Ontario and observed differences in the composition of species found in DCR discharge areas compared to reference areas. Three mechanisms were proposed for this community shift: physical disturbance, contaminant effects, and coarsening and de-enrichment of sediment. Physical disturbance would be the result of addition of DCR to the substrate that leads to an increase of early colonizing species. Contaminant effects would be those effects influencing species composition through the toxicity of sediments. A coarsening and de-enrichment of the sediment would affect those species with grain size and organic content preferences.

Offshore Great Lakes Benthic Indicator Species—*Diporeia* spp

The Great Lakes Water Quality Agreement of 1978 calls for the use of the small shrimp-like amphipod *Diporeia* spp. as an indicator of the biological integrity of the offshore regions of the lakes. A goal of 220 to 320 amphipods per square meter at depths less than 328 feet (100 meters), and from 30 to 160 amphipods per square meter at greater depths has been set as these abundances of *Diporeia* are considered indicative of good environmental conditions (Scharold et al., 2004).

The amphipod *Diporeia hoyi* (formerly *Pontoporeia hoyi*) was the most abundant macroinvertebrate in the Great Lakes (Mozley and Howmiller, 1977; Nalepa, 1991). In deeper water habitats, it accounted for 40 to 70 percent of the total density of benthic organisms (Nalepa, 1991), reaching greatest densities at depths below the summer thermocline in waters 98 to 197 feet (30 to 60 meters) deep. GLNPO has conducted benthic invertebrate sampling in the Great Lakes and has monitored the density of *Diporeia hoyi*. Figure 3-12 presents the 2004 densities of *Diporeia hoyi* at GLNPO sampling stations with DCR track lines based on actual coordinates of DCR sweeping documented from USCG (2002) and USCG (2006).

Diporeia spp. is the most abundant benthic organism in the cold, offshore regions (deeper than 98 feet, or 30 m) of each lake (SOLEC, 2005) and is important to the diet of many Great Lakes fish. For example, sculpin feed almost exclusively upon *Diporeia* spp. Sculpin are then fed upon by lake trout (*Salvelinus namaycush*). Lake whitefish (*Coregonus clupeaformis*), an important commercial species, also feed heavily on *Diporeia* spp. (SOLEC, 2007). *Diporeia* spp. also is important in assessing open lake conditions because it is sensitive to low-oxygen concentrations and numerous toxins (Nalepa and Landrum, 1988).

Between 1994 and 2000, *Diporeia* spp. densities declined in Lake Michigan from an average of 5,200 to 1,800 per square meter. In 2005, the average density was only 300 per square meter (NOAA, 2006). In Lake Erie, *Diporeia* spp. was reduced from 1,844 per square meter in 1979 to 218 per square meter in 1993, becoming absent at 8 of 13 sampling locations (Dermott and Kerec, 1995). In Lake Ontario, *Diporeia* spp. declined rapidly, from over 6,000 per square meter in 1992 to 0 in 1995 at depths less than 328 feet (100 meters), while increasing from 1,050 to 5,230 per square meter at the midlake basin site (Dermott, 2001).

These data indicate that some areas of the Great Lakes already are below the *Diporeia* spp. goal (220 to 320 amphipods per square meter), and *Diporeia* spp. densities are quickly declining in other areas. Continued declines in *Diporeia* spp. density could adversely affect the biological integrity of the Great Lakes.

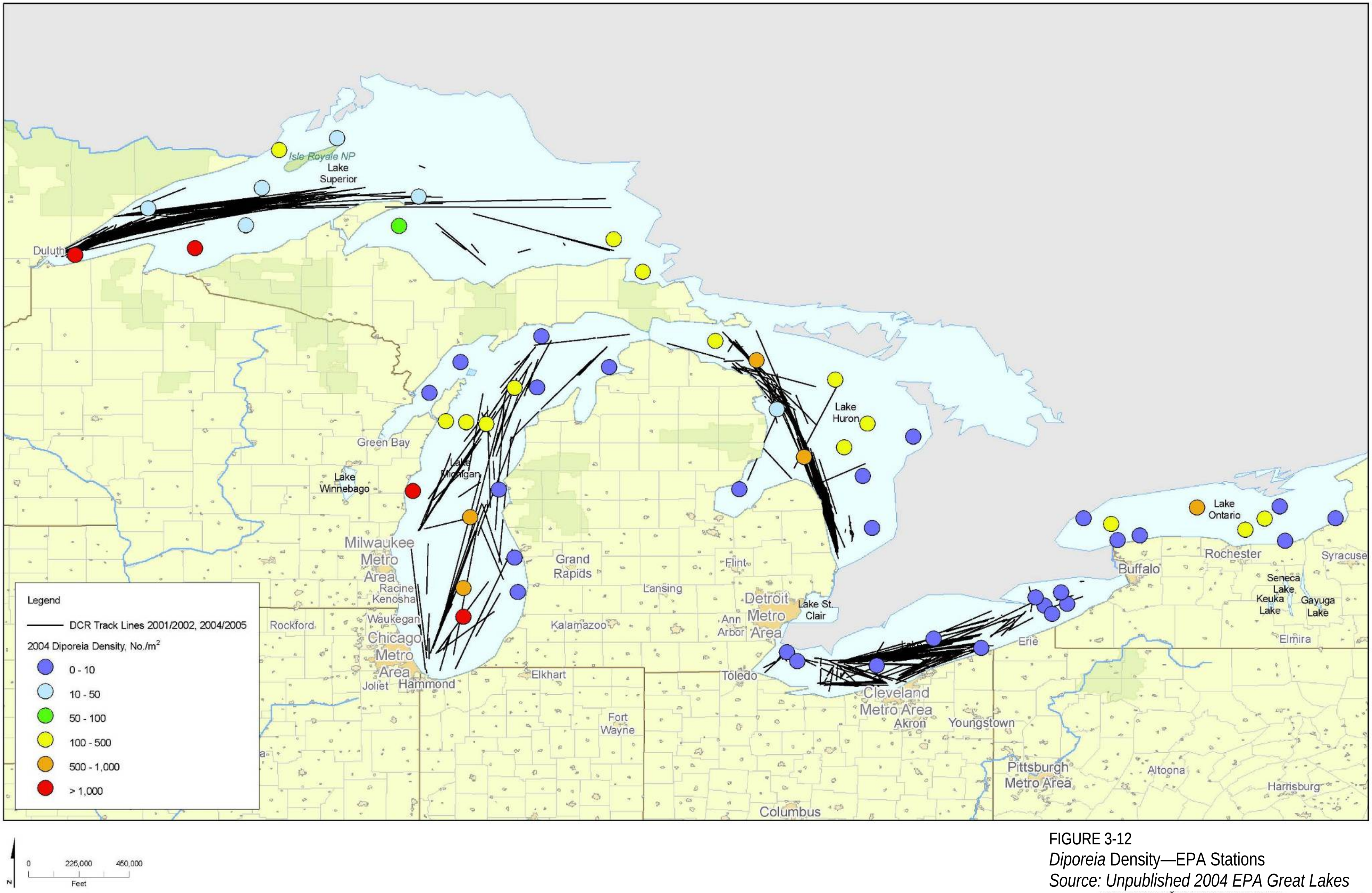

FIGURE 3-12
Diporeia Density—EPA Stations
Source: Unpublished 2004 EPA Great Lakes

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Declines in all of the lakes coincided with the introduction and rapid spread of the zebra and quagga mussels. It is possible that the dreissenid mussels are out-competing *Diporeia* for available food. However, evidence for the decline appears to be more complex, as *Diporeia* has completely disappeared from areas where food is available and where there are no local populations of mussels (SOLEC, 2007).

3.3.4.4 Fish and Other Pelagic/Planktonic Organisms

Fish as well as pelagic and planktonic organisms inhabit the pelagic zone, which is defined as that part of the open lake that is not near the shoreline or lake bottom. DCR sweepings swept from ships will pass through the pelagic zone, and therefore animals living in this zone could be affected by changes in physical conditions or water quality. Fish also are associated with the lake bottom because either they feed on benthic invertebrates or they spawn at or near the lake bottom, or both. As such, DCR sweepings settling near the lake bottom could affect fish habitat.

Fish

The Great Lakes region constitutes the largest continuous mass of freshwater in the world. These lakes have supported one of the world's largest freshwater fisheries for over 100 years. There are approximately 180 species of fish indigenous to the Great Lakes. A variety of species inhabits nearshore areas (for example, smallmouth bass [*Micropterus dolomieu*], northern pike [*Esox lucius*], and channel catfish [*Ictalurus punctatus*]), whereas others reside primarily within the pelagic zone (for example, lake herring [*Coregonus artedii*], walleye [*Stizostedion vitreum*], and lake trout [*Salvelinus namaycush]*) (GLFC, 2002). Most of the species in the Great Lakes are native; however, species such as alewife (*Alosa pseudoharengus*), brown trout (*Salmo trutta*), carp (*Cyprinus carpio*), round goby (*Neogobius melanostomas*), ruffe (*Gymnocephalus cernuus*), and sea lamprey (*Petromyzon marinus*) have been introduced from other regions and are considered exotics (GLERL, 2004).

The Great Lakes fishery has changed dramatically over the past 100 years. Many native fish species have been lost because of overfishing, pollution, invasions by non-native species, and natural changes. The fishery has rebounded, with the exception of Lake Ontario, and some native fish are making a comeback because of government-imposed fishing quotas, reductions in pollution, efforts in controlling invasive species, and habitat restoration projects (EPA, 2001).

Commercial fishing in the Great Lakes began in the 1800s. Lake herring (*Coregonus artedi)*, rainbow smelt (*Osmerus mordax*), lake whitefish (*Coregonus clupeaformis*), and yellow perch (*Perca flavescens*) are of commercial importance in Lake Superior, while the lake whitefish is commercially important in Lake Huron. The Lake Ontario fishery has declined substantially due to the presence of contaminants and the main species harvested were the American eel (*Anguilla rostrata*), yellow perch, bullheads, sunfish, and rock bass (*Ambloplites rupestris*) (University of Guelph, 2007). Concentrations of organochlorine contaminants in Great Lakes sport fish generally are decreasing. However, in the United States, PCBs drive consumption advisories of Great Lakes sport fish. In Ontario, most of the consumption advisories for Great Lakes sport fish are driven by PCBs, mercury, and dioxins. Toxaphene also contributes to consumption advisories of sport fish from Lake Superior and Lake Huron (SOLEC, 2007). Today, most commercial fish are caught in Lake Erie (smelt, yellow perch, and walleye) and Lake Michigan (lake whitefish and alewife [*Alosa pseudoharengus*]) (Fuller et al., 1995).

As described in Chapter 2, fish nursery and spawning habitats are ecological resources that are sensitive to DCR sweeping and representative of the ecological health of the Great Lakes. Spawning and nursery habitats represent sensitive environments of limited distribution and are necessary to maintain fish populations. Because of the large number of fish species indigenous to the Great Lakes, representative species were selected as a means of characterizing the range of spawning and nursery habitats.

Table 3-15 briefly describes the preferred habitats of representative fish species in the Great Lakes, indicates whether the species had spawning or nursery habitat in the open waters of one or more of the Great Lakes, and if the species were of particular value to commercial or sport fisheries, or as an important component of the ecosystem (for example, an important forage food) in one or more of the Great Lakes.

Historic spawning and nursery habitat data were obtained for 11 representative Great Lakes species in Goodyear et al. (1982). The atlas lists all species and any known spawning and nursery habitat discovered in each lake, dating back to the 1800s in some instances. Not all species with spawning/nursery habitat within the lake open waters were included in Table 3-15 and in cases where two or more species of the same family occupy similar spawning and nursery habitat, one or two species were chosen to represent the family. The representative species of concern are those with spawning and nursery habitat found along the shorelines or in deeper waters of the Great Lakes. Species that use shoreline areas and deeper waters as spawning and nursery areas are more susceptible to DCR sweepings than those that use riverine habitats. Threatened or endangered species, or species of special concern such as the lake sturgeon, were added to Table 3-15.

TABLE 3-15
Local Importance, Habitat, and Presence of Selected Fish Species of Concern

Species	Latin Name	Importance	Spawning/ Nursery Habitat	Lake Huron	Lake Ontario	Lake Michigan	Lake Erie	Lake Superior
Yellow perch	Perca flavescens	Sport, commercial	Shallow bays, up to 20 ft	Present	Present	Present	Present	Present
Walleye	Sander vitreus	Sport, commercial	Shallow bays, up to 20 ft	Present	Present	Present	Present	Present
Emerald shiner	Notropis atherinoides	Forage	Young found by shoreline areas in lake proper	**Few present**	**Few present**	Present	Present	**Few present**
Spottail shiner	Notropis hudsonius	Forage	Young found by shoreline areas in lake proper, less than 30 ft	**Few present**	**Few present**	Present	Present	**Few present**
Alewife	Alosa pseudoharengus	Forage	Bays, rivers, and shorelines with sand and gravel up to 30 ft	Present	Present	Present	Present	Present
Lake whitefish	Coregonus clupeaformis	Sport, commercial	6 to 75 ft; sand, gravel, small stones, rocky reefs	Present	Present	Present	Present	Present
Lake herring	Coregonus artedi	Forage; few remain	0 to 180 ft; pelagic spawners	Present	Present	Present	Present	Present
Bloater	Coregonus hoyi	Forage; former commercial	Offshore, up to 500 ft	Present	**Unknown**	Present	**Absent**	Present
Lake trout	Salvelinus namaycush	Sport	Rocky reefs, up to 500 ft	**Few present**	**Few present**	Present	Present	**Few present**
Rainbow smelt	Osmerus mordax	Forage	Spawn in rivers; young found by shoreline areas in lake proper	Present	Present	Present	Present	Present
Lake sturgeon	Acipenser fulvescens	Sport / commercial/ T&E	Riverine	**Unknown**	**Absent**	**Few present**	**Unknown**	**Few present**

Source: Goodyear et al., 1982.

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Pelagic/Planktonic Organisms

Pelagic and planktonic organisms reside within the water column and consist primarily of phytoplankton (microscopic single-celled plants) and zooplankton (microscopic animals). Phytoplankton and zooplankton could potentially be adversely affected by chemicals released into the water column by DCR sweepings. Phytoplankton also could be affected if DCR sweepings were to increase the concentrations of nutrients that phytoplankton rely on for growth and survival. This could result in an increased phytoplankton population (that is, a plankton bloom), which also could adversely affect water quality.

Species found in the pelagic zones of the Great Lakes may include one or more life stages of amphipods or scuds, leeches, arthropods or daphnia, freshwater shrimp (*Mysis* spp.), and copepods. These organisms are able to move in the water column, although their movement is more restricted than that of fishes. Open-water crustacean zooplankton communities in the Great Lakes, except Lake Ontario, are dominated in the spring by one of several species of copepods called diaptomid copepods (Barbiero et al., 2001). The relative abundance and diversity of zooplankton was observed to increase in the summer with the appearance of cladocerans. There was a high degree of spatial homogeneity in the Lake Superior, Lake Michigan, and Lake Huron communities, which were dominated by diaptomid copepods, cyclopoid copepodites, and cladocerans. The lake with the greatest zooplankton species diversity was Lake Erie. Lake Ontario was unique, with its relative lack of calanoid copepods and abundance of cyclopoid copepods along with Bosmina and Daphnia. Community composition also was observed to be different between the eastern and western regions of Lake Ontario (Barbiero et al., 2001).

Based on the results of the EPA's Biological Open Water Surveillance Program, which included an examination of all the lakes during spring and summer 1998, the Great Lakes are highly diverse in terms of phytoplankton, with each lake typically supporting over 100 species during spring and summer (Barbiero and Tuchman, 2001). One group of phytoplankton (diatoms) was dominant in the spring in all lakes except Lake Superior. In spring, the biomass of phytoplankton in Lake Superior was very low compared to that in the other Great Lakes, averaging only 0.085 g/m^3. Biomass in Lake Michigan was 0.26 g/m^3, and in Lakes Erie and Ontario was 0.52 g/m^3 (Lake Superior Technical Committee Meeting, 2000).

Similar densities were found in Lake Michigan during a study from 1983 to 1992 (Makarewicz et al., 1994). Diatoms become less abundant in the summer, with chrysophytes, or golden algae, dominating populations in the upper lakes and chlorophytes, or green algae, dominating populations in the lower lakes. Lakes Superior, Huron, and Michigan tend to have similar community structures, which differ from those in Lakes Erie and Ontario (Barbiero and Tuchman, 2001).

The phytoplankton and productivity of the Great Lakes also have been studied by Munawar and Munawar (1986). Their study indicated that the eutrophic/mesotrophic lower Great Lakes exhibited well-developed seasonal peaks of high biomass, with spring maximum abundances most pronounced in the inshore region (Munawar and Munawar, 1986). The oligotrophic Upper Great Lakes (that is, Superior, Huron, and Michigan) had low biomass and generally lacked well-developed seasonal patterns; no seasonal trends were observed in Lake Superior, which was described as being ultra-oligotrophic. The seasonality of biomass and various taxonomic groups of phytoplankton showed differentiation between individual lakes as the Lower Great Lakes (Erie and Ontario) were found to harbor eutrophic and mesotrophic species and the Upper Great Lakes harbored oligotrophic species.

3.3.4.5 Invasive Species

Invasive species in the Great Lakes are a concern relative to DCR sweeping because some invasive species (primarily mollusks) require a hard substrate to thrive. Much of the substrate in the Great Lakes in the areas receiving DCR sweepings consists of soft substrates (sand or mud). However, the sweeping of certain types of DCR (for example, taconite) in some cases may be enhancing the amount of hard substrates in these soft-bottomed areas of the Great Lakes, which could increase the available habitat for these types of invasive species.

Since the 1800s, at least 136 nonindigenous aquatic organisms have become established in the Great Lakes (Great Lakes Commission, 2004). Most of these organisms have been plants (61), followed by fish (24), algae (24), mollusks (9), and oligochaetes (7). More than one-third of the organisms have been introduced in the past 30 years, a surge coinciding with the opening of the St. Lawrence Seaway. Two major entry mechanisms—unintentional releases (37 percent) and ships (32 percent)—were responsible for all but one introduction in the period from 1960 to 1990 (Great Lakes Commission, 2004). Because of the interconnectedness of the Great Lakes, a species' introduction in one lake is likely to lead to its expansion into all of the Great Lakes.

Nearshore Shallow Water

The nearshore areas of the Great Lakes are likely to contain a greater number of invasive species than the offshore areas because a greater proportion of plants and animals inhabit nearshore areas. Furthermore, many of the invasive species are plants, which are typically found in shallow-water habitats. Eurasian milfoil is an example of a common invasive plant found in shallow water habitats of the Great Lakes, including Superior Bay and Chequamegon Bay of Lake Superior. Eurasian milfoil can clog waterways in shallower areas because of its ability to form dense mats (GLIN, 2007a).

Other invasive species of the shallow-water environment include mollusks such as the zebra mussel, crustaceans such as the spiny water flea, and fish such as the sea lamprey and white perch. These species, however, are not bound to shallow-water areas and can be found in offshore areas as well. Whereas zebra mussel adults are attached to harder substrates, young mussels, called veligers, are broadcast into the water column. Sea lamprey and white perch entered the Great Lakes by swimming up the St. Lawrence River from the Atlantic Ocean through manmade canals (GLIN, 2007a).

Invasive Mussels

There is potential for swept DCR to provide substrates for the colonization of the invasive zebra mussel and quagga mussel in the Great Lakes. The realization of this potential depends largely on the species' environmental requirements and life history. These conditions are summarized below to form the basis for DCR impact prediction in the following chapter of the EIS.

Zebra mussels are considered native to the Black Sea, Caspian Sea, and Ural River areas of Eurasia, and quagga mussels are indigenous to the Dneiper River drainage of Ukraine. Both species have expanded into most major drainages in Europe. Zebra and quagga mussels in the Great Lakes have their origins from many sources in northwestern and north central Europe (Jentes, 2001), where substantial shipping to the Great Lakes originates. Zebra mussels were first discovered in Lake St. Clair in 1988; quagga mussels were first noted in Lake Erie in 1989.

Temperature, calcium, pH, dissolved oxygen, and depth are important factors governing the survival and distribution of the mussels. The zebra mussel requirements for these factors are better known because they have been recognized as an invasive species in the Great Lakes for a longer period. The available information indicates that the requirements for the two species differ for several of these parameters (Table 3-16).

Substrate type may be one of the most critical factors for the mussels, in general, and particularly in relation to DCR because the physical characteristics of the substrate can be altered by the sweeping of DCR. Juvenile and adult zebra mussels are epifaunal, that is, they typically reside at the sediment–water interface, and generally are anchored to the substrate (Karatayev et al., 1998). They are most abundant on hard surfaces (Mellina and Rasmussen, 1994), particularly rocky surfaces.

TABLE 3-16
Environmental Requirements for Great Lakes Invasive Mussels

Parameter	Zebra	Quagga	Reference
Preferred temperature (°C)	10–25	As low as 5	Paukstis et al. (1997), Karatayev et al. (1998), Claudi and Mackie (1994), Roe and MacIsaac (1997)
Preferred calcium level (mg/L)	44–50	Perhaps higher than for zebra mussels	Sprung (1987), Jones and Ricciardi (2005)
Preferred pH	7.4–9.3	Presumed similar to zebra mussels	Sprung (1987), Bowman and Baily (1998)
Preferred dissolved oxygen (% saturation)	At least 25	Perhaps lower than for zebra mussels	Karatayev et al. (1998)
Preferred depth (ft)	15–25	Up to at least 300	Mills et al. (1993, 1999), Egan (2006)

However, preference for hard substrates may diminish over time as zebra mussels become established in an area and juveniles colonize old shell. This can result in expansion onto adjacent soft substrates such as sand, mud, and gravel (Hunter and Bailey, 1992; Berkman et al., 2000). Zebra mussels will colonize on any hard surface and can reach densities of up to 30,000 to 70,000 mussels per square meter (2,800 to 6,500 mussels per square foot) under certain conditions. Zebra mussels also will colonize soft, silty lake bottoms where harder objects are deposited to serve as substrate (Reutter, 1995). Zebra mussels also will attach to one another, growing to thicknesses of up to 150 mm (6 inches) (O'Neill, 1996).

In contrast, quagga mussels appear to be able to colonize hard and soft substrates. They have formed extensive colonies on soft sediment in Lake Erie (Dermott and Munawar, 1993; Dermott and Kerec, 1997; Roe and MacIsaac, 1997; Reutter, 1995). Egan (2006) indicated that in Lake Michigan they can colonize sand, clay, and pebbles, but not soft mud.

Although zebra mussels appeared first in the Great Lakes, it seems that the quagga mussel is now replacing the zebra as the dominant species. The apparent broader environmental conditions tolerated by the quagga (for example, depth and temperature) and ability to colonize soft sediments give the species an advantage.

Immature life stages of both mussel species are small, unshelled forms, or veligers, that drift in the water column with the currents. Once they reach a size at which they can settle by gravity, the mussel veligers drift downward with currents until they encounter a suitable attachment surface. Once settled, they attach to surfaces by secreting a tuft of fibers known as byssal threads. Each thread has an adhesive disk at its end that attaches to surfaces by secreting an adhesive protein (Claudi and Mackie, 1994).

Adult mussels can move from the original settling location either by crawling, which can occur at rates up to several meters per day (Maryland Sea Grant, 1994), or by moving with currents after detachment. Adults generally will only reposition themselves to find a more advantageous location to obtain food. To a lesser extent, waterfowl and other aquatic organisms also assist in the dispersal of these mussels.

Zebra and quagga mussels have caused major ecological and economic problems since their arrival in North America. Both species are prodigious water filterers, removing substantial amounts of phytoplankton and suspended particulates from the water. By removing the phytoplankton, they in turn decrease the food source for zooplankton, therefore altering the food web (Claxton and Mackie, 1998). Water clarity increases light penetration, causing a proliferation of aquatic plants that can change species dominance and alter the entire ecosystem. Zebra and quagga mussels can accumulate organic pollutants in their tissues to concentrations more than 300,000 times greater than those concentrations in the environment. These pollutants can be passed up the food web and increase wildlife exposure to organic pollutants (Snyder et al., 1997). Another major threat involves the fouling of native freshwater mussels.

The ability to rapidly colonize hard surfaces causes serious economic problems. Organisms can clog water intake structures, such as pipes and screens, thereby reducing pumping capabilities for power and water treatment plants, costing industries, companies, and communities. Recreation-based industries and activities have also been affected; docks, breakwalls, buoys, boats, and beaches have all been heavily colonized.

A population shift has occurred within the *Dreissena* genus since the early 1990s. The large shell size and low respiration rates of quagga mussels are competitive advantages against the zebra mussel and may explain their increasing dominance between the two species (Stoeckmann, 2003). In 1992 quagga mussels greatly outnumbered zebra mussels only in the eastern basin of Lake Erie, but now the entire lake is dominated with quagga mussels (Mills et al., 1993; Patterson et al., 2002). An area of periodic summer anoxia is the only region of the basin that has not been colonized with *Dreissena* (Dermott and Munawar, 1993).

Currently, Lake Superior does not have a large *Dreissena* invasion. No quagga mussels were observed in Lake Superior in a 2002 survey; however, they were observed in 2005 and in 2007, as expected, due to their ability to spawn at lower temperatures and their low food supply needs (Grigorovich et al., 2003; EPA, 2007; Benson and Raikow, 2007). The current area of reproduction is in the Duluth-Superior harbor (Minnesota Sea Grant, 2007). Doug

Jenson, with the Minnesota Sea Grant (personal communication, October 15, 2007), attributed the isolated harbor colonization to the harbor's being less influenced by Lake Superior and having shallower, warmer waters with higher calcium levels. Jenson also commented that despite the large magnitude of larva floating from the Duluth-Superior harbor into the western basin, no massive colonies exist in the larger lake. Because of Lake Superior's low calcium levels, Jenson (personal communication, October 15, 2007) does not believe quagga mussel colonization will be as large scale as the other Great Lakes.

Nearshore localized anoxia is possible in Lake Michigan and may account for the absence of *Dreissena* near Michigan City (David Bunnell, U.S. Geological Survey, personal communication, October 17, 2007). Bottom trawls at stations throughout Lake Michigan from 1999 confirmed lake-wide distribution of *Dreissena*; however, the distribution could not be fully explained by substrate and bathymetry alone (Fleischer et al., 2001).

3.3.4.6 Waterfowl

It is estimated that more than 100 species of birds are either totally or partially dependent on the Great Lakes basin wetlands (Environment Canada, 2007b) most of which are protected under the Migratory Bird Treaty Act (MBTA) of 1918. Birds found in the Great Lakes include ducks, shorebirds, gulls and terns, herons and egrets, geese (*Branta* spp.) swans (*Cygnus* spp.), and raptors (GLIN, 2007b). Miscellaneous birds not contained in these major groups include coots (*Fulica Americana*), grebes, and moorhens (*Gallinula chloropus*) (GLIN, 2007b). The sandy beach areas of the Great Lakes provide excellent shorebird habitat.

Most waterfowl species (geese, swans, and ducks) are associated with the shallow water areas of the Great Lakes. Geese feed on grains, grass sprouts, and some aquatic vegetation, while swans feed on aquatic vegetation and shore grasses. Surface-feeding ducks, such as the mallard, feed in shallow waters on primarily aquatic vegetation but also consume fish and other aquatic organisms. Some waterfowl species are diving or deep-water-foraging, and include grebes, mergansers, cormorants (*Phalacrocorax* spp.), loons (*Gavia* spp.), and certain ducks such as the canvasback (*Aythya valisineria*), greater and lesser scaup (*Aythya marila* and *Aythya affinis*, respectively), redhead duck (*Aythya americana*), and ring-necked duck (*Aythya collaris*). These species feed primarily on fish and mussels; however, water depth limits the areas within which they can forage. Only a few of these species, such as the cormorant, forage in offshore areas, at depths generally less than 30 feet, but up to 70 feet deep (Palmer, 1962). These areas may coincide with DCR sweeping areas.

3.3.5 Socioeconomic Environment

The CEQ defines the "human environment" to include the natural and physical environment and the relationship of people with that environment. Economic activity typically encompasses employment, personal income, and industrial or commercial output and growth. Data on industry or sector employment, personal income, and industrial or commercial output and growth can provide insight on the linkage between a given industry or sector and the economic health of a region.

3.3.5.1 Economic Systems

As previously discussed, since this DEIS addresses the impacts of dry cargo residue sweeping which essentially occur offshore and within shipping lanes, the following areas are not addressed: land use, housing, cultural resources, traffic, and water-dependent recreation other than fishing.

Dry Bulk Carrier Industry

The dry bulk cargo industry in the Great Lakes is made up primarily of U.S. and Canadian lakers, with both nations' laws reserving domestic (lakewise) commerce to their own flag vessels. The U.S. and Canadian Great Lakes dry bulk carrier fleet is described in Section 1.1.2. International bulk dry cargo trade in the Great Lakes is mostly cross-lake traffic between U.S. and Canadian ports, but ships flying the flags of the U.S., and of Canada and other foreign nations connect the Lakes with all parts of the world, via the St. Lawrence Seaway. Lakewise dry bulk traffic between U.S. ports (almost 65 percent of total Great Lakes traffic in 2004) is a much larger portion of the total dry bulk cargo volume than cross-lake commerce with Canada (only 7 percent of dry cargo carried by U.S. vessels) (MARAD 2005). Table 1-2 contains the U.S. fleet historical shipping information.

Some U.S. Great Lakes dry bulk vessels have fixed routes and schedules, sailing between just a few ports, but most vessels have a more flexible regimen, to optimize value and minimize empty runs. This typically means that the vessels carry a variety of different cargos, one for each port-to-port leg of a deployment, with most cargo moving less than 50 statute miles to or from ports (MARAD, 2005). Self-unloading equipment adds to fleet efficiency by enabling quick turnaround in ports.

U.S. Great Lakes Shipping Dependent Industries

Mining and steel, and energy are the primary customers of the Great Lakes dry bulk cargo waterborne carriers. The region's other major industries include automobile manufacturing, heavy machinery, paper mills, metalworking and shipbuilding.

3.3.5.2 Water-Dependent Infrastructure

Infrastructure is the foundation that supports most economic activity. Water-dependent infrastructure relating to the dry bulk cargo industry chiefly includes shipping lanes and ports, and is most affected by public and private investment in new projects and improvements, as well as maintenance expenditures. The Great Lakes dry bulk carrier industry expects that public investment will be directed toward navigation locks and dams in the next five years, while most if not all new investment for loading equipment, storage capacity and docks will come from the private sector (MARAD, 2005).

Commercial Shipping Lanes

Waterborne commerce on the Great Lakes has the advantage of an integrated navigation system with infrastructure that is already in place, whereas the costs to expand highways and rail lines are high and major new thoroughfares may cover substantial areas of land. Recent Short Sea Shipping initiatives emphasize the waterborne advantage. However, as recently underscored, there are still dredging requirements to maintain efficient commerce in the Lakes and that has financial and other costs.

Great Lakes shipping lanes are operated under a Traffic Separation Scheme (TSS), an internationally recognized vessel routing system that separates opposing flows of vessel traffic into lanes to promote efficiency and prevent collisions. The Great Lakes shipping lanes are arranged as upbound (to the west) and downbound (to the east) lanes, with multiple shipping lanes crossing different portions of each lake. The IEP reflects the shipping routes in laying out the exclusion areas.

Port Facilities

Most port facilities are private - the seven U.S.-flag operators (companies) in the 2005 MARAD survey collectively stated that 85 percent of their cargo was loaded and 93 percent was swept at private (customer-owned) port facilities (MARAD, 2005). Major elements of the port facilities that relate to this DEIS are the material handling systems and procedures for loading and unloading the vessels. Those are addressed elsewhere in this DEIS under the vessel operation descriptions and the control measures in the alternatives.

A major problem for U.S. Great Lakes waterborne commerce is insufficient water depth at certain ports, due to a decrease in Lakes' water levels and of the need for dredging. Vessels have to "light-load" cargo at some ports, with the degree depending on ports served. Five of seven operators responding to the MARAD survey had to light-load on over 75 percent of their voyages over the previous five years due to insufficient water depth. Eighteen ports were cited as being too shallow, and they accounted for 53 percent of the total Lakewise traffic in 2004, with the top five of those ports representing 40 percent (MARAD, 2005). Most of the U.S. Great Lakes commercial harbors are maintained by the Army Corps of Engineers, with the others under private control. In the mid-1990s annual dredging costs were as much as $33 million. (Allardice and Thorp, 1995).

3.3.5.3 Fishing

The commercial fishery on the Great Lakes is valued at more than $1 billion annually and the sport fishery at more than $4 billion annually. The commercial fishery harvests about 65 million pounds of fish per year including whitefish, smelt, walleye, and perch. The sport fishery is a blend of native and introduced species, some of which are regularly restocked, including salmon, steelhead, walleye, lake trout, perch and bass. (GLIN, 2007a). Section 3.3.4.4 further describes Great Lakes fish species and fisheries.

The U.S. Geological Survey's Great Lakes Science Center has conducted lake-wide surveys of the fish communities since 1978 in Lake Superior, and since 1973 in Lake Michigan and Lake Huron. Lake Superior supports a variety of commercially and recreationally significant self-sustaining fish species. It is the only Great Lake that has maintained a majority of its native species, and during the past 20 years has undergone progress toward restoration of lake trout, lake whitefish, and lake herring (GLSC, 2004b). Predominant prey fish found in a 2004 survey of Lake Superior included (in order of dominance by biomass) lake whitefish, lake herring, bloater, longnose sucker, and rainbow smelt. Lake whitefish and rainbow smelt biomass remained at similar levels from 2003 to 2004, while hatchery lake trout reached their lowest biomass over all the survey years (Stockwell et al., 2005).

Total prey fish biomass in Lake Michigan has shown a declining trend since 1989 (Madenjian et al., 2005). Research on the potential effects of vessel navigation on fish populations in the St. Mary's River, Michigan was conducted from 1993 through 1996, focusing on lake herring spawning areas. The study did not identify any significant effects of navigation activities on St. Mary's River fish populations (MDNR, 1997).

Lake Huron appears to have lost a substantial amount of pelagic fish biomass between 1997 and 2004-2005, with changes in species composition, abundance, and size structure resulting in an approximate 66 percent decrease in total fish density. The decrease was due to loss of alewife and decreased abundance of rainbow smelt and bloaters (Schaeffer et al. 2005).

Lake Erie fish stocks are multimillion dollar resources that are vitally important to the commercial and sport fishing industries of Michigan, Ohio, Pennsylvania, and New York, as well as Ontario. The abundance and harvest availability of these stocks have been altered by overfishing, habitat alteration, environmental degradation, and the influx of nonindigenous species during the past century (GLSC, 2004c). The goal for Lake Ontario is maintaining well-balanced fish populations that produce harvestable surpluses for sport and commercial fisheries and restoring a self-sustaining lake trout population. (GLSC, 2004d).

3.3.5.4 Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The EO was created to ensure the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. USCG policy contained in COMDTINST 5810.3, Coast Guard Environmental Justice Strategy, directs the USCG to "conduct its programs, policies and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies and activities, because of their race, color or national origin."

CHAPTER 4

Environmental Consequences

4.1 Introduction

This section discusses the potential for, and significance of, environmental and economic consequences associated with implementing any of the project alternatives including the No Action alternative. Chapter 3's discussion of the affected environment was based on a review of available information for the entire Great Lakes system as well as site-specific data collected in the geographic areas most affected by past or future DCR sweeping activity. Since DCR sweeping has occurred in the Great Lakes for over a century, existing conditions represent the influence of the sweeping under conditions similar to the Proposed Action's (IEP as Coast Guard Regulation with Recordkeeping). Thus the impacts of this alternative are described first and reflect the detailed evaluation of impacts measured in the Great Lakes and presented in Appendix N. To the extent possible for the current rule making, the impacts of past practices have been measured and form the basis of impact prediction for all of the alternatives.

Although at least one State, Michigan, has a statute that may prohibit the sweeping of DCR within State waters, this rulemaking does not factor that into the environmental impact analysis. This rulemaking does not preempt State laws, and the Coast Guard does not want to speculate on any action by Michigan or any other State. For this reason for the scope of this analysis we use the continuance of DCR sweeping as currently known for the impacts assessment for Alternatives 2–5.

If an alternative to the Proposed Action alters the amount or condition (such as location) of DCR sweeping from the current condition, the impacts of the alternative are expressed as a variation (greater or lesser) from the measured condition and quantified where feasible. These changes would be to the long-term impacts and would not occur in the short term (because following the reduction in DCR sweeping practices, several years of natural sedimentation and altered sweeping would be required to alter the conditions). These evaluations are presented by resource area in the same order as in Chapter 3, and the impacts of the various alternatives are compared in Chapter 7. A table summarizing the comparison of the impacts of the various alternatives also is presented in Chapter 7.

4.2 Standards of Significance Criteria

Criteria for evaluating potential impacts to the affected environment and determining the significance of the impacts are outlined by CEQ in the definition of "significantly" (40 CFR 1508.27). The regulations state that significance is determined by the intensity or severity of the impact and the context in which it occurs. Intensity criteria are based on the following:

- Degree of change to unique geographic characteristics, such as visual quality, harbors, archaeological sites, wetlands, or ecologically critical areas

- Potential for environmental or scientific controversy
- Degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks
- Potential for establishing a precedent for future actions or representing a decision in principle about a future consideration
- Relation of the impact to other, individually insignificant actions but with cumulatively significant impacts
- Degree to which endangered or threatened species or their habitats may be affected
- Potential for violation of Federal, State, or local environmental standards

Using these criteria, three levels of impacts were identified:

- **No Impact.** Implementation of the action or the alternative has negligible or no effect, either adverse or beneficial, on the resource.
- **Insignificant Impact.** Implementation of the action or alternative has an effect, either adverse or beneficial, but the impact does not exceed the established threshold for significance and is generally considered minor.
- **Significant Impact.** Implementation of the action or alternative would cause a major alteration or have a major effect on the resource, either adverse or beneficial.

Impacts may be reduced by implementing appropriate mitigation measures. Mitigation measures can affect operational requirements and economic factors. Therefore these factors must be considered when proposing mitigation measures.

The same impact criteria for a given resource were applied for each of the Great Lakes. For all but invasive species, the criteria were applied to all the lakes as a single system. However, there are substantial differences among lakes in factors affecting invasive species; therefore the criteria were applied to each lake individually. As described below (Section 4.6.5) the differing conditions among lakes resulted in differing levels of invasive species impacts in individual lakes.

4.3 Impact Summary

The CEQ guidance for EISs calls for a summary and categorization of impacts in terms of the following "CEQ impact categories":

- **Direct Impacts.** Changes in an environmental resource that are in immediate temporal or spatial proximity to an activity of the proposed action.
- **Indirect Impacts.** Changes in an environmental resource that result from a direct impact of the Proposed Action. They are one or more steps removed from an immediate temporal or special change in a resource.

- **Short-Term Impacts.** Changes in an environmental resource that are finite in duration, do not persist for the entire duration of the Proposed Action, and occur generally immediately upon implementation of the Proposed Action.
- **Long-Term Impacts.** Changes in an environmental resource that persist as long as the Proposed Action. For projects involving construction of a facility, the impacts associated with the actual construction are considered short term and impacts occurring during operation of the constructed facility are considered long term.
- **Adverse Effects That Cannot Be Avoided.** Negative changes in an environmental resource that result from implementation of the essence of the Proposed Action and would occur even with mitigation.
- **Relationship Between Short-Term Use of the Environment and Long-Term Productivity.** Description of relative environmental costs resulting from direct consumption or change in an environmental resource versus the relative environmental cost from loss of environmental productivity over the duration of the change.
- **Irreversible and Irretrievable Commitment of Resources.** Consumption of a resource or change so severe the function of the resource is lost in perpetuity.

Where impacts are identified for an alternative, they are summarized in terms of each of the CEQ impact categories. The discussion is presented below for each of the resources potentially affected by the Proposed Action or other alternatives (sediment quality, water quality biological, and socioeconomic resources) under the heading of Impact Summary.

The following sections describe the environmental consequences to certain resources affected by alternatives discussed in Chapter 2. The discussion focuses on those resources that are potentially affected by DCR sweeping (as described in Chapter 3). These resources were identified based on input from an interdisciplinary team, the public, and past documentation. Potential resource impacts are described in terms of context and intensity (no impact, insignificant, or significant).

Each resource is discussed individually. Included in the discussion are a definition of the resource, the methodology and criteria used to assess impacts to it, and the effect of each alternative on it.

4.4 Sediment Quality

This section evaluates the impacts of each alternative on the quality of sediments in the area of concern. Impacts to sediment quality were assessed by evaluating potential effects of DCR on sediment chemistry, physical changes to sediments, and deposition rates. Each of these topics is addressed below under separate heading for each alternative.

4.4.1 Sediment Chemistry

The evaluation of impacts to sediment chemistry focused on the potential direct input of toxic chemicals from DCR to the Great Lakes and potential adverse effects of those chemicals on sediment quality. The criteria used, from MacDonald et al. (2000), are freshwater sediment quality guidelines. The guidelines were derived from threshold effect concentrations (the concentration below which adverse effects are not expected to occur) and probable effect concentrations (the level above which adverse effects are expected to occur more often than not), and compared to Great Lakes sediments not influenced by DCR.

The evaluation of impacts to sediment chemistry focused on the effects of iron ore, coal, and limestone DCR. There are other types of DCR, but as detailed in Appendix N, the characteristics of the other DCR types do not pose any potential impact (from toxicity or physical characteristics) that is not exhibited by iron ore, coal, or limestone. Also the mass and frequency of other types of DCR swept are much smaller (generally less than 3 percent) than those of iron ore, coal, or limestone. Thus any impacts of the targeted DCR types would be much greater than impacts of other types, and therefore with the greatest potential to impact sediment with the exception of salt.

The sweeping of salt also may affect the sediment chemistry, but it was assumed that there are no potential direct or indirect impacts from salt residue after the maximum annual sweeping rate of salt—0.118 lbs/acre, or 53.5 g/acre, in Lake Erie (USCG, 2006)—was compared to the estimated rate of dissolution in the water column. Using the physiochemical properties of halite and an equation from Langmuir (1997) for mineral dissolution in aqueous systems, a dissolution rate of 2.9 g/s was calculated for halite entering the water column. Salt would, therefore, dissolve in less than 20 seconds if discharged at the maximum sweeping rate of 53.5 g/acre (53.5 g of salt is roughly equal to a cube 3 centimeters on a side). In this time, an undissolved portion is unlikely to reach the sediment floor. Since the diffusion rates in sediment are also very low, the extent of salinity change from any undissolved portions of salt would be limited to only a few centimeters and last only a few minutes at most.

Impacts to this resource were evaluated as follows.

No Impact

If no DCR were swept under the alternative, or if chemicals attributable to DCR (as determined from chemical analyses of DCR described in Appendix L) were predicted not to occur in lake sediments at concentrations greater than the threshold effect concentrations values or concentrations in reference areas (Table 8 in Appendix L), then no impact to sediment chemistry would be expected.

Insignificant Impact

If one or more chemicals attributable to DCR were to occur in lake sediments outside the exclusion areas (that is, within shipping track lines, where DCR sweeping is expected to occur) at concentrations greater than the threshold effect concentrations but less than the probable effect concentrations, then an insignificant impact to sediment chemistry would be expected.

Significant Impact

If one or more chemicals attributable to DCR were to occur in lake sediments outside the exclusion areas at concentrations greater than the probable effect concentrations, then a significant impact to sediment chemistry would be expected.

4.4.1.1 Sediment Chemistry Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no long term, short term, direct or indirect impacts to sediment chemistry because no chemicals attributable to DCR are predicted to occur in lake sediments at concentrations greater than the values present in reference areas. The management of DCR would remain virtually the same as it has for the past few decades. Thus, future sediment chemistry (as well as sediment physical structure and deposition rate) conditions would be very similar to existing conditions, as described in Chapter 3, Affected Environment, and the impacts would be very similar to the impact of existing operations, described in Appendix N. The only possible variation from this scenario would be that due to mandatory recordkeeping. Greater attention to DCR management because of mandatory recordkeeping could result in small decreases in DCR sweeping and greater adherence to exclusion areas. However, the amount of reduction that would take place cannot be projected, and thus to avoid underpredicting the effects of this alternative, we consider the impacts to be the same as those for current operations.

As described in Chapter 3, DCR is detectable on the lake floor. However, the effects of over a century of DCR sweeping on sediment quality or biological resources are barely detectable. Consequently, it would be difficult to project the effects of a single DCR sweeping or even a full year of sweeping. Thus the impacts of the Proposed Action described below for sediment chemistry and subsequently for sediment physical structure and deposition rate are considered long-term because the practice that produced current conditions has occurred for over a century. Similarly, the impacts predicted for other alternatives in subsequent sections reflect a long-term, steady state situation. In the following sections, any potential for short-term impacts (generally 6 to 10 years) was considered and identified if it was considered likely.

The evaluation of sediment chemistry consisted of three independent analyses (Appendix N), including mathematical calculation of sediment concentrations based on DCR sweeping rates, measurement of DCR chemistry and toxicity, and measurement of sediment chemistry and toxicity in areas of greatest DCR sweeping. For all three analyses, elevated concentrations of chemicals attributable to DCR were not measured or predicted to occur in sediment. Although sediment concentrations exceeded some threshold effect concentrations values in DCR sweeping areas and some toxicity was observed, the sediment concentrations were similar to those in reference areas, and the toxicity does not appear to be associated with any chemical constituent attributable to DCR.

4.4.1.2 Sediment Chemistry Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under this alternative, there would be no long term, short term, direct or indirect impacts to sediment chemistry because no chemicals attributable to DCR are predicted to occur in lake sediments at concentrations greater than the values present in reference areas. The sediment chemistry conditions would be the same as described above for the Proposed Action.

4.4.1.3 Sediment Chemistry Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under this alternative, there would be no long term, short term, direct or indirect impacts to sediment chemistry. Under the Proposed Action with DCR Control Measures on Ships alternative, less sediment would be swept than under the Proposed Action. However, there is a relatively high degree of uncertainty in the quantification of reduced sweeping and thus a reliable prediction in a shift from insignificant impact on physical structure to no impact is not justified.

TABLE 4-1
Average Mass of DCR Swept per Event from the Five Lowest-Discharging Ships In The Great Lakes

Ship (Company)	Average Mass of DCR per Washdown Event (Lbs/Event)
Walter J. McCarthy (ASC)	143
Adam E. Cornelius (ASC)	137
John J. Boland (ASC)	136
Paul R. Tregurtha (ISC)	128
Buffalo (ASC)	29

The reduction of DCR sweeping attributable to improvements in cargo ships' equipment was projected by comparing the average estimated amount of DCR swept by ships with the smallest volume of sweeping to the estimated amount swept from all ships. The ships with the least sweepings were built in the 1970s, after implementation of the Merchant Marine Act of 1970, the purpose of which was to modernize the U.S. marine fleet. Ships built after the implementation of this Act are likely to already have some or all of the DCR control measures described in Chapter 2. The average mass of DCR (iron ore, coal, and limestone only) swept per event for the five lowest-discharging ships, which were built in the 1970s, is presented in Appendix O and Table 4-1.

The average of these five ships is 123 lbs per event. For all ships in the Great Lakes, the average estimated mass of DCR (iron ore, coal, and limestone) swept per washdown event is 206 lbs. Based on this comparison, it may be possible to reduce the average amount of DCR swept per ship event by 40 percent, and a similar reduction in the amount of DCR in sediment could be expected. Since no impact to sediment chemistry was predicted under the Proposed Action alternative, this level of impact would not change with a reduction of DCR in sediment.

4.4.1.4 Sediment Chemistry Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

Under this alternative, there would be no long term, short term, direct or indirect impacts to sediment chemistry. Impacts to sediment chemistry for the Proposed Action with Shoreside DCR Control Measures alternative would be less than under the Proposed Action and similar to the impacts of Proposed Action with DCR Control Measures on Ships. However, as with the Proposed Action with DCR Control Measures on Ships, there is too much uncertainty in the quantification of reduced sweeping to make a reliable prediction in a shift between impact criteria. Thus, the impacts of this alternative are expected to be the same as those for the Proposed Action with DCR Control Measures on Ships.

4.4.1.5 Sediment Chemistry Impacts of Alternative 1—No Action

Under this alternative, there would be no long term, short term, direct or indirect impacts to sediment chemistry. With the cessation of DCR sweeping, over time the natural sedimentation would gradually bury historically deposited DCR and the sediments in the historic DCR deposition areas would mirror the reference areas.

4.4.2 Physical Structure

The physical structure of the sediments was evaluated by assessing the potential for DCR sweepings to alter the composition of the sediments, as indicated by grain size, to the degree that the habitat for benthic, or sediment-dwelling, organisms, as indicated by benthic samples, would be affected adversely. Impacts to this resource were categorized as follows.

No Impact

If DCR were not swept under the alternative or if DCR could be swept but sediment samples collected in the DCR sweeping areas had grain size distributions similar to those of sediments in reference areas, then no adverse or beneficial impact to sediment physical structure would be expected. Grain size particle distributions were quantitatively determined by hydrometer analysis of sediment samples. The DCR sweeping and reference areas' particle distributions, given as the percent of particles in each size category, were then qualitatively compared.

Insignificant Impact

If the sediment grain size distributions in the DCR sweeping areas were noticeably different than those in reference areas, but benthic community samples showed no decrease in diversity, then an insignificant impact to sediment physical structure would be expected.

Significant Impact

If the grain size distributions in sediments outside the exclusion areas were substantially different than those in reference areas and showed less habitat diversity, as indicated in benthic community samples, a significant impact to sediment physical structure would be expected.

4.4.2.1 Physical Structure Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be direct, long-term impacts considered insignificant to sediment physical structure. A coarsening and de-enrichment mechanism is possible in the physical structure of the sediment since noticeable grain size differences that may be attributable to DCR were found (Appendix H).The results of the study do not suggest a physical disturbance mechanism, but the results are limited by the small sample size and number of taxa collected, as compared to those of Maher (1999).

Impacts to sediment physical structure, defined as noticeable grain size differences among sediments from DCR sweeping areas, may occur in at least some areas of intense DCR. This is evidenced by identification of concentrated areas of DCR on the lake floor during historic deposition analysis (Appendix I). It also is based on the noticeable difference in grain size distribution in deposition and reference areas of Lake Michigan (Appendix H).

4.4.2.2 Physical Structure Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under this alternative, there would be direct, long-term impacts considered insignificant to sediment physical structure. The impact in most of the lakes would be the same as described above for the proposed action. However, in the near shore area (within 3 statute miles) there would be no impact because there would be no sweeping of limestone and clean stone (which can occur under the IEP). It would take a number of years for the historically deposited limestone and clean stone to be buried by natural deposition.

4.4.2.3 Physical Structure Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

The Proposed Action with DCR Control Measures on Ships would produce direct, long-term impacts considered insignificant to sediment physical structure. The type of impacts would be the same as described above for the Proposed Action. However, as described above, the control measures could possibly reduce DCR sweeping by as much as 40 percent, compared to the Proposed Action. The impact to sediment physical structure (insignificant), defined by a noticeable effect on grain size, would be reduced, but there is too much uncertainty to predict effects consistent with the no-impact criterion. There also is considerable uncertainty in attributing all or most of this DCR reduction to DCR control measures on ships, as several other factors, such as more modern and efficient equipment to convey the dry cargo, may be involved. Apportionment of the reduction to specific DCR control measures also is not feasible.

4.4.2.4 Physical Structure Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The impacts of this alternative on physical structure, direct and long-term, would be considered insignificant and the same as the predicted impacts for Proposed Action with DCR Control Measures on Ships. Also as discussed above for the control measures on ship alternative there is a high degree of uncertainty with the prediction and inability to apportion the reduction in impact to specific DCR control measures.

4.4.2.5 Physical Structure Impacts of Alternative 1—No Action

Under this alternative, there would be no long term, short term, direct or indirect impacts to sediment physical structure. The impacts of the No Action alternative on the physical structure of the sediments would be less than the impacts predicted on physical structure resulting from the Proposed Action. Initially, there would be no difference in impacts between the No Action and the Proposed Action alternatives. However, as explained below, in time, natural deposition would bury the historically deposited DCR and there would be no impact to physical structure because the surface sediments (which are the ones that interact with the ecological resources) would be native material with no evidence of DCR.

Natural sedimentation rates (and thus burial of already deposited DCR) in the Great Lakes vary by location and are reported to range generally from 0.2 to 6 mm/year (Appendix P). As it settles through the water column, DCR may be initially buried to approximately 7 mm on deposition at the lake bottom (Appendix Q). On average, after 10 years, DCR currently on the lake floor would be buried to a depth of approximately 40 mm, which would be the lower limit of sediment depth that directly interacts with ecological resources and processes. Thus it would require at least 10 years following implementation of the No Action alternative for improvements in the physical structure of sediments to be manifested, and could be considered a long term insignificant beneficial impact.

4.4.3 DCR Deposition Rate

The impact of DCR deposition rate was evaluated to determine whether the rate of DCR deposition could affect sediment quality by smothering benthic organisms or their habitats. Impacts resulting from DCR deposition rates were evaluated as follows.

No Impact

If DCR were not swept under the alternative, or if the combined natural and DCR annual deposition rate were in the range of the natural deposition rate alone, then no impact to benthic organisms would be expected.

Insignificant Impact

If the rate of predicted DCR deposition combined with natural sediment deposition were no more than 10 percent greater than the maximum natural sediment deposition rates, an amount considered to be reasonably small by expert opinion, then an insignificant impact to benthic organisms would be expected.

Significant Impact

If the rate of predicted DCR deposition combined with natural sediment deposition were more than 10 percent greater than the maximum natural sediment deposition rate, then a significant impact to benthic organisms would be expected.

4.4.3.1 DCR Deposition Rate Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no long term, short term, direct or indirect impacts to deposition rates from DCR because the combined natural and DCR annual deposition rates are in the range of natural deposition rates. DCR deposition rates were found to be approximately 0.2 percent or less of the natural deposition rate even in the areas of highest DCR sweeping activity (Appendix N). Benthic organisms have evolved to tolerate natural sedimentation rates, and such small increases, even within a small area, would not affect the sediment environment.

4.4.3.2 DCR Deposition Rate Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

For this alternative there would be no long term, short term, direct or indirect impact to sediment DCR deposition rate. Under this alternative, the DCR deposition rate would be slightly less than under the Proposed Action in modified exclusion areas. The amount of DCR currently swept in exclusion areas that would be swept outside of modified exclusions areas under this alternative is expected to be too small, especially when compared to the total amount already swept outside of the exclusions areas in the Great Lakes, to have a noticeable effect on DCR deposition rate.

4.4.3.3 DCR Deposition Rate Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under this alternative, there would be no long term, short term, direct or indirect impacts to deposition rates from DCR sweeping. Compared to the Proposed Action, the predicted deposition rate could possibly be as much as 40 percent less under the DCR Control Measures on Ships alternative. Thus the impact could be less than expected under the Proposed Action.

4.4.3.4 DCR Deposition Rate Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The DCR deposition rate impacts from this alternative would be the same as for the similar alternative with control measures on ships: no long term, short term, direct or indirect impacts to deposition rates from DCR sweeping.

4.4.3.5 DCR Deposition Rate Impacts of Alternative 1—No Action

Since there would be no DCR swept under No Action, the alternative would have no long term, short term, direct or indirect impact on DCR deposition rates.

4.4.4 Sediment Quality Impact Summary

As described above, the only sediment quality impact is an insignificant adverse impact on sediment physical structure and the impact is similar for all alternatives except No Action, where there is no adverse impact (Table 4-2). The impact is direct in that the change in physical structure is immediate and occurs within the DCR sweeping area. It is long term because the change in physical structure persists as long as DCR sweeping occurs. In fact, the impact would persist up to 10 years after any DCR sweepings were terminated, until the DCR was buried by natural sedimentation. The insignificant adverse affects that occur on the sediment physical structure cannot be avoided. As discussed in Chapter 5, the impacts can be reduced by reducing the amount of DCR swept, but, except for the No Action alternative, all alternatives (even with mitigation) result in sweeping and deposition in the lake sediments of DCR , and the resulting change in physical structure is unavoidable. There is no consumption, significant change, or irreversible commitment of resource related to sediment quality predicted for any of the alternatives.

TABLE 4-2
Comparison of Alternatives Based on Significance Criteria: Sediment Quality

Resource	No Action	Proposed Action	Modified Exclusion Areas	DCR Control Measures	
				Ship	Shore
Sediment chemistry	○	○	○	○	○
Sediment physical structure	○	◍	◍	◍	◍
DCR deposition rate	○	○	○	○	○

○ No adverse impact. ◌ Impact, but impact less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact. ● Significant adverse impact.

4.5 Water Quality

Alterations in Great Lakes water quality, either chemical or physical, can affect human health, recreation, the presence and density of aquatic species, ecosystem function, the water's assimilative capacity, and its use as drinking water. Thus, determination of changes in water quality from any of the alternatives is paramount to determining changes in other attributes of the Great Lakes. The water quality components that could be influenced by any of the DCR alternatives are water chemistry, nutrient enrichment, and dissolved oxygen concentration. Each of these factors is evaluated for each of the alternatives in the following sections.

4.5.1 Water Chemistry

The evaluation of impacts to water chemistry focused on the potential input of toxic chemicals from DCR to the Great Lakes and the potential adverse effects of those chemicals on water quality. Impacts to water chemistry were evaluated as follows.

No Impact

No impact to water chemistry would be expected if DCR were not swept under the alternative or if chemicals attributable to DCR were not predicted to occur in the water column, even in the mixing zone (Appendix P), at concentrations greater than GLI chronic values for surface water or, where GLI values are not available, other applicable chronic values (Table 8 in Appendix L).

Insignificant Impact

An alternative was considered to have an insignificant impact if either of the following conditions were met:

- One or more chemicals attributable to DCR were predicted to occur in the water column in the DCR mixing zone (based on the sweepings discharge analysis) at concentrations greater than GLI chronic screening values but less than GLI acute values.
- No chemicals attributable to DCR were predicted to occur in the water column in DCR sweeping areas outside the mixing zone at concentrations greater than GLI chronic values.

Significant Impact

A significant impact was expected if any of the following criteria were met:

- One or more chemicals attributable to DCR were to occur in the water column outside the DCR discharge mixing zone at concentrations greater than GLI chronic values.
- One or more chemicals attributable to DCR were predicted to occur in the water column in the DCR discharge mixing zone at concentrations greater than GLI acute values.

4.5.1.1 Water Chemistry Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under this alternative, the management of DCR would remain virtually the same as it has for the past few decades. Thus, future water quality conditions would be very similar to existing conditions, as described in Chapter 3, and the impacts would be very similar to the impact of existing operations, described in Appendix N.

Under the Proposed Action, there would be no long term, short term, direct or indirect impacts to water chemistry because chemicals attributable to DCR are not predicted to occur in the water column, even in the mixing zone (Appendix P), at concentrations greater than GLI chronic values for surface water or, where GLI values are not available, other applicable chronic values (Table 8 in Appendix L). The analytical results of liquid sump samples and simulated deck sweepings that were collected from eight bulk dry cargo vessels (Appendix L) as well as the mathematical simulation of DCR discharge dilution (Appendix P) were used to evaluate the change in lake water concentration as compared to screening values, and thus water chemistry impact from DCR sweepings. The analysis found that the sweeping of DCR would not result in any water quality criteria being exceeded, even for the chemical with the highest concentration in relation to criteria, and even if the receiving water were already very close to the criteria (Appendices N and P).

4.5.1.2 Water Chemistry Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to water chemistry under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.5.1.3 Water Chemistry Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct or indirect impacts to water chemistry from the control measures on ships alternative. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.5.1.4 Water Chemistry Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures on Ships

The water chemistry impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.5.1.5 Water Chemistry Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long-term, short-term, direct, or indirect impacts to water chemistry.

4.5.2 Nutrient Enrichment

The evaluation of impacts to water quality from nutrient enrichment focused on the potential for DCR to enhance or inhibit algal growth in the Great Lakes, which could affect water quality adversely (Appendix R). Impacts to nutrient enrichment were evaluated as follows.

No Impact

If DCR were not swept under the alternative or if no substantial stimulation or inhibition of algal growth was predicted to occur from exposure to 100 percent DCR slurries—as measured by exposure to simulated DCR slurries—then no impact to nutrient enrichment would be expected.

Insignificant Impact

If no substantial stimulation or inhibition of algal growth were to occur based on predicted DCR concentrations outside the DCR discharge mixing zone, then an insignificant impact would be expected.

Significant Impact

If algal growth were stimulated or inhibited by a factor of more than 10 percent from predicted DCR concentrations outside the DCR discharge mixing zone, then a significant impact would be expected.

4.5.2.1 Nutrient Enrichment Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action alternative, there would be no long term, short term, direct or indirect impact to nutrient enrichment. There was little difference between nutrient concentrations in simulated DCR slurry and the lake water, and after dilution, there would be no measurable change in nutrient concentrations resulting from DCR sweeping. Slightly increased aquatic plant production was observed when DCR was introduced at high concentrations, but the effects were diminished at tested dilutions, and no change is anticipated at the dilutions expected from DCR sweeping (Appendices L and R).

4.5.2.2 Nutrient Enrichment Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to nutrient enrichment under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.5.2.3 Nutrient Enrichment Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct or indirect impacts to nutrient enrichment from the control measures on ships alternative. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.5.2.4 Nutrient Enrichment Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures on Ships

The nutrient enrichment impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.5.2.5 Nutrient Enrichment Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to nutrient enrichment.

4.5.3 Dissolved Oxygen

The evaluation of impacts to water quality from alterations of dissolved oxygen concentrations focused on the potential for DCR to deplete dissolved oxygen concentrations through increased biochemical oxygen demand (BOD) or chemical oxygen demand (COD). Impacts to this resource were evaluated as follows.

No Impact

If DCR were not swept under the alternative or if an increase in BOD or COD was not predicted to occur inside or outside the DCR discharge mixing zone compared to the range of naturally occurring oxygen demand in the Great Lakes, then no impact to dissolved oxygen would be expected.

Insignificant Impact

If DCR was not predicted to have a measurable increase in BOD or COD inside the DCR mixing zone, then an insignificant impact to dissolved oxygen would be expected.

Significant Impact

If DCR was predicted to result in a measurable increase in BOD or COD outside the DCR mixing zone, then a significant impact to dissolved oxygen would be expected.

4.5.3.1 Dissolved Oxygen Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no long term, short term, direct or indirect impact to dissolved oxygen. Impacts to dissolved oxygen were evaluated with measurements of BOD and COD in the sump liquid and simulated deck sweepings from the eight vessels (Appendix L). Neither BOD nor COD was elevated in any of the simulated deck sweepings or sump liquid samples above what might be expected in typical stormwater runoff (25 mg/L total BOD and COD). The low level of predicted oxygen demand strongly indicates no impact. Also, the high initial dilution would prevent any lowering of DO in surface waters (Appendix P).

4.5.3.2 Dissolved Oxygen Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to dissolved oxygen under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.5.3.3 Dissolved Oxygen Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct or indirect impacts to dissolved oxygen from the control measures on ships alternative. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.5.3.4 Dissolved Oxygen Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures on Ships

The dissolved oxygen impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.5.3.5 Dissolved Oxygen Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to dissolved oxygen.

4.5.4 Water Quality Impact Summary

As described above and summarized in Table 4-3, there are no impacts on water quality. Thus, there are no impacts that fall within the CEQ impact categories.

TABLE 4-3
Comparison of Alternatives Based on Significance Criteria: Water Quality

Resource	No Action	Proposed Action	Modified Exclusion Areas	DCR Control Measures	
				Ship	Shore
Water chemistry	○	○	○	○	○
Nutrient enrichment	○	○	○	○	○
Dissolved oxygen	○	○	○	○	○

○ No adverse impact. ◌ Impact, but impact less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact. ● Significant adverse impact.

4.6 Biological Resources

Biological resources considered include special status species, protected and sensitive habitat areas, the benthic community, fish and other pelagic organisms, invasive species, and waterfowl. Each of these topics is addressed below under separate heading for each alternative.

4.6.1 Special Status Species

Federal, State, and local agencies were contacted to determine the possible presence of any special status (e.g., threatened or endangered) plant and animal species in the Great Lakes as documented in Appendix G. Impacts to these resources were evaluated as follows.

No Impact

No special status species are present, or if there are, there is no interaction between the sweeping of DCR and special status species.

Insignificant Impact

There is interaction between the sweeping of DCR and special status species, but there are no adverse effects on individuals, populations, or habitat.

Significant Impact

The sweeping of DCR could potentially jeopardize the continued existence of any special status species or result in the destruction or adverse modification of the habitat of such species.

4.6.1.1 Special Status Species Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action alternative, the management of DCR would remain virtually the same as it has for the past few decades. Thus, future conditions would be very similar to existing conditions, as described in Chapter 3, and the impacts would be very similar to those of existing operations, described in Appendix N.

Under the Proposed Action, there would be no long term, short term, direct or indirect impact to special status species because there is no interaction between the sweeping of DCR and special status species. Confirmation from U.S. Fish and Wildlife Service is pending.

4.6.1.2 Special Status Species Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to special status species under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.6.1.3 Special Status Species Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct, or indirect impacts to special status species from the control measures on ships alternative because up to possibly 40 percent less DCR would be swept compared to the Proposed Action. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.6.1.4 Special Status Species Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures on Ships

The special status species impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.6.1.5 Special Status Species Impacts of Alternative 1—No Action

Under the No Action Alternative, there would be no sweeping of DCR, thereby removing the potential to affect any special status species. Therefore there would be no long term, short term, direct or indirect impacts to special status species.

4.6.2 Protected and Sensitive Areas

As described in Chapter 3, there are two types of protected and sensitive areas throughout the Great Lakes. There are a number of areas designated for protection or management by state or federal agencies and there are areas identified as sensitive habitat during a multi-agency and stakeholder workshop on management of DCR (Reid and Meadows, 1999) or as part of the evaluation conducted in this EIS. Impacts to these resources were evaluated as follows.

No Impact

An alternative was considered to have no impact if no DCR sweepings were to occur within any protected or sensitive areas, as described in Chapter 3.

Insignificant Impact

An alternative was considered to have an insignificant impact if DCR sweepings are allowed in protected or sensitive areas (described in Chapter 3) but the alternative would not alter or otherwise adversely affect the sensitive or protected resource.

Significant Impact

A significant impact could be expected if DCR sweepings are allowed in protected or sensitive areas, as described in Chapter 3, and adverse effects to the habitats could occur.

4.6.2.1 Protected and Sensitive Areas Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be an insignificant adverse impact on water-based protected and sensitive areas and the impact would be direct and long term. Many of the protected and sensitive areas described in Chapter 3 are land based (Table 4-4) and it is logistically impossible for there to be DCR sweepings in these areas. Thus there is no impact to the land-based protected and sensitive areas.

TABLE 4-4
Land-Based Protected and Sensitive Areas (DCR Sweeping Logistically Not Possible)

Lake	Area
Superior	Apostle Islands National Lake Shore (B)
	Pictured Rocks National Lake Shore (E)
Superior	Huron National Wildlife Refuge (D)
	Whittlesey National Wildlife Refuge (C)
Huron	Harbor Island National Wildlife Refuge (K)
	Michigan Islands National Wildlife Refuge (F)
Michigan	Sleeping Bear Dunes National Lake Shore (G)
	Indiana Dunes National Lake Shore (H)
	Michigan Islands National Wildlife Refuge (F)

TABLE 4-4
Land-Based Protected and Sensitive Areas (DCR Sweeping Logistically Not Possible)

Lake	Area
Erie	Cedar Point National Wildlife Refuge (N)
	Ottawa National Wildlife Refuge (O)
	West Sister Island National Wildlife Refuge (P)
	Old Woman Creek National Estuarine Research Reserve (Q)

Note: See Figure 3-11 for areas' letter designations.

As indicated in Table 4-5, under the Proposed Action (which incorporates the current IEP) the sweeping of limestone and clean stone is allowed in four designated or managed areas (Thunder Bay NMS; Northern Refuge, shallow reefs near Beaver Island; Isle Royale National Park; and Detroit River NWR). In addition, under the Proposed Action sweeping would be allowed in two other sensitive habitats (Green Bay and the Western Basin of Lake Erie). Limestone and clean stone would be allowed in both areas. In the Western Basin of Lake Erie coal, taconite, and salt could be swept within the dredged channels from ships loading and loading from ports within the Western Basin. As described above the rate of DCR deposition is well within the range of natural deposition rates and as described below the sweeping is not expected to have an impact on critical biological resources. Also the sweeping of coal, taconite and salt is confined to dredged channels which are periodical disturbed; the dredging would prevent build up of DCR in the sediment. Because the sweeping of DCR is allowed within certain portions of protected and sensitive areas, and because the alternative would not alter or otherwise adversely affect the resource, there would be a direct insignificant adverse impact..

TABLE 4-5
Allowed DCR Sweepings and Degree of Impact in Protected and Sensitive Areas

Resource						
Lake	**Name**	**Proposed Action**	**Modified Exclusion**	**Ship DCR Controls**	**Shoreside DCR Controls**	**No Action**
Designated or Managed Areas						
Superior	Isle Royale National Park (A)	Only limestone and clean stone sweeping allowed	NDA	Only and clean stone limestone sweeping allowed	Only limestone and clean stone sweeping allowed	NDA
Huron	Thunder Bay National Marine Sanctuary (L)	Limestone and clean stone sweeping allowed; other DCR allowed beyond 12 miles	NDA	Limestone and clean stone sweeping allowed; other DCR allowed beyond 12 miles	Limestone and clean stone sweeping allowed; other DCR allowed beyond 12 miles	NDA
Michigan	Milwaukee Mid-Lake Protection Area (I)	NDA	NDA	NDA	NDA	NDA
	Northern Refuge, shallow reefs near Beaver Island (J)	Only limestone and clean stone sweeping allowed	NDA	Only limestone and clean stone sweeping allowed	Only limestone and clean stone sweeping allowed	NDA
Erie	Detroit River National Wildlife Refuge (M)	Only limestone and clean stone sweeping allowed	NDA	Only limestone and clean stone sweeping allowed	Only limestone and clean stone sweeping allowed	NDA
Other Sensitive Habitats						
Superior	Caribou Island and Southwest Protection Area (R)	NDA	NDA	NDA	NDA	NDA
	Stannard Rock Protection Area (S)	NDA	NDA	NDA	NDA	NDA
	Superior Shoal Protection Area (T)	NDA	NDA	NDA	NDA	NDA
Huron	Saginaw Bay (W)	NDA	NDA	NDA	NDA	NDA
	Six Fathom Scarp Mid-Lake Protection Area (X)	NDA	NDA	NDA	NDA	NDA
Michigan	Waukegan Protection Area (U)	NDA	NDA	NDA	NDA	NDA

TABLE 4-5
Allowed DCR Sweepings and Degree of Impact in Protected and Sensitive Areas

Resource						
Lake	**Name**	**Proposed Action**	**Modified Exclusion**	**Ship DCR Controls**	**Shoreside DCR Controls**	**No Action**
	Green Bay (V)	Only limestone and clean stone sweeping allowed	Only limestone and clean stone sweeping allowed for ships loading and unloading within Green Bay	Only limestone and clean stone sweeping allowed	Only limestone and clean stone sweeping allowed	NDA
Erie	Western Basin (Y)	Selected DCR in channel only; limestone and clean stone anywhere	Selected DCR in channel only; Limestone and clean stone only for ships loading and unloading in Western Basin	Selected DCR in channel only; limestone and clean stone anywhere	Selected DCR in channel only; limestone and clean stone anywhere	NDA

Note: NDA, no sweeping allowed; thus no impact. Unshaded cells denote no impact; shaded table cells denote insignificant impact. Miles are statue miles. See Figure 3-11 for areas' letter designations.

4.6.2.2 Protected and Sensitive Areas Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

The impacts to protected and sensitive areas under the Modified Exclusion Areas alternative would be long term, direct, and insignificant. DCR sweeping to all protected and sensitive areas can be eliminated except: coal, taconite, and salt sweepings to the dredged channels for ships transporting cargo totally within the Western Basin of Lake Erie; and limestone and clean stone anywhere in Green Bay and Western Basin of Lake Erie for ships transporting cargo totally within these areas (Table 4-5). The sweeping into these areas is allowed under the current IEP and prohibiting the sweeping would prevent the significant shipping among ports in the basin which currently takes place. The 1994 GLERL workshop held with NOAA and other resource agencies considered the continuation of this practice to have an acceptable level of impact, if the sweeping is confined to dredged channels. The evaluation of DCR related impacts to Sediment, Water Quality, and Biological resources discussed in this chapter is consistent with the finding of the GLERL workshop. Thus, there would not be an adverse impact or alteration of the protected and sensitive resources in the Western Basin of Lake Erie and the impact level is insignificant. Even though the impacts to protected and sensitive areas are classified as insignificant for all the action alternatives, they are less under this alternative than under the Proposed Action because sweeping is confined to dredged channels and locally operating ships. To illustrate this lower level of impacts to protected and sensitive areas, a category of "between no impact and insignificant impact" was added for comparative purposes in the summary of impacts to biological resources below and in Chapter 7.

4.6.2.3 Protected and Sensitive Areas Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

The impacts from this alternative on protected and sensitive resources would be the same as for the Proposed Action: long term, direct and insignificant. As described above for the Proposed Action, sweepings would be allowed in several protected and sensitive areas but no adverse impact or alteration to the protected and sensitive areas is expected.

4.6.2.4 Protected and Sensitive Areas Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures on Ships

The impacts of Proposed Action with Shoreside DCR Control Measures on Ships on protected and sensitive resources would be the same as for the Proposed Action; long term, direct and insignificant. As described above for the Proposed Action, sweepings would be allowed in several protected and sensitive areas but no adverse impact or alteration to the protected and sensitive areas is expected.

4.6.2.5 Protected and Sensitive Areas Impacts of Alternative 1—No Action

Under the No Action Alternative, there would be no sweeping of DCR, thereby removing the potential to affect any protected and sensitive areas. Therefore there would be no long term, short term, direct or indirect impacts to special status species.

4.6.3 Benthic Community

The benthic community comprises the assemblage of interacting organisms found at or near the bottom of the Great Lakes. It consists of organisms that generally reside in or on the upper part of lake sediments or are in contact with lake sediments much of the time.

Impacts to the benthic community were evaluated by comparing the structure and composition of the benthic invertebrate community in areas of high-intensity DCR sweeping with those of community structures in reference areas outside the DCR sweeping areas. The comparisons were based on the following parameters:

- Bulk sediment toxicity of sediments from current DCR sweeping areas compared with those from reference areas (Appendix N).
- Toxicity of DCR sweepings compared with toxicity of laboratory control sediments (Appendix S).
- Benthic community structure of sediments from current DCR sweeping areas compared with those from reference areas (Appendix N).
- Chemical tissue residues in benthic organisms in the DCR sweeping areas compared with those of organisms from the reference areas (Appendix N).

Impacts to the benthic community were evaluated as follows.

No Impact

An alternative was considered to have no impact to the benthic community if DCR sweepings were not allowed or if all of the following conditions were met under an alternative that involves the sweeping of DCR:

- The benthic community structures outside the exclusion areas (that is, within shipping track lines where DCR sweeping are expected to occur) were similar to those in reference areas.
- No adverse effects were found in survival or growth of test organisms exposed to sediments from outside the exclusion areas relative to the response of test organisms exposed to sediment from reference areas outside the DCR sweeping areas (based on statistical analyses of laboratory test results).
- No chemicals attributable to DCR were found in the tissue of benthic organisms collected from outside the exclusion areas at levels above the range of those in the tissue of benthic organisms collected from reference areas.
- The survival and growth of test organisms exposed to DCR, with the minimum dilution expected within high DCR sweeping areas, were similar to those of test organisms exposed to reference sediments.

Insignificant Impact

An alternative was considered to have an insignificant impact to the benthic community if any of the following conditions were met:

- The benthic community structures outside the exclusion areas were similar to those of reference areas or—if the communities varied widely—the benthic communities outside the exclusion areas were not considered impaired and densities of benthic organisms were similar.
- Differences in growth but not on survival were found on test organisms exposed to sediments from outside the exclusion areas relative to the response of test organisms exposed to sediment from reference areas outside the DCR sweeping areas (based on statistical analyses of laboratory test results).
- Chemicals attributable to DCR (as determined from chemical analysis of DCR; Appendix L) were found in the tissue of benthic organisms at levels above those in benthic organisms from reference areas, but below levels likely to pose a significant risk to the organisms or to those that might feed on them (based on food chain modeling). Literature-based (see Appendix N) tissue residue levels associated with adverse effects to aquatic organisms were used to determine potential risk.

Significant Impact

An alternative was considered to have a significant impact if any of the following conditions were met:

- The benthic community structure outside the exclusion areas was found to be impaired relative to reference areas.
- There were adverse effects on survival and growth of test organisms exposed to sediments from outside the exclusion areas relative to the response of test organisms exposed to sediment from reference areas (based on statistical analyses of laboratory test results).
- There were adverse effects on survival and growth of test organisms exposed to diluted DCR relative to the response of test organisms exposed to sediment from reference areas (based on statistical analyses of laboratory test results).
- Chemicals attributable to DCR were found in the tissue of benthic organisms at levels above those in the tissue of organisms collected from reference areas and at levels likely to pose a risk to the organisms or to those that might feed on them (based on food chain modeling).

4.6.3.1 Benthic Community Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be long term and indirect insignificant impacts to the benthic community. The impact is indirect because it results from the direct impact on sediment physical structure caused by the addition of DCR to the sediment. Based on the results described in Appendices L, K, and S and summarized in Appendix N, DCR sweeping has the potential to produce slightly higher diversity and relative abundance of certain species in the benthic community. Therefore no adverse effect would be predicted based on these results alone. The composition of the benthic community from samples collected from DCR sweeping areas and of the benthic community from reference areas conducted to support this EIS showed no differences. However, these samples were small subsamples of the community and may not completely reflect community structure. As described in Appendix N, Maher (1999) performed a more extensive evaluation of benthic community structure in Lake Ontario and observed differences in the composition of species found in DCR sweeping areas compared to reference areas, possibly as a result of alteration in the physical structure of the sediment. Also, as described above, the sweeping of DCR could change the physical structure of the sediment, which could produce a corresponding alteration in the benthic habitat and community structure in limited areas of intense DCR sweeping and accumulation.

Although toxicity testing results from both DCR sweeping areas and reference areas showed lower survival than the laboratory control for many samples, and there were only a few differences between the DCR sweeping area and the reference areas in both survival and growth, this is considered an insignificant impact because the effects observed do not appear to be associated with any DCR-related chemical constituent. No impact is predicted based on benthic community tissue data because chemicals in the tissue of benthic organisms from DCR sweeping areas are at levels similar to those in the tissue of benthic organisms from reference areas.

4.6.3.2 Benthic Community Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to the benthic community under this alternative would be the same as those predicted for the Proposed Action: there would be long term and indirect insignificant impacts. The impacts in the shallow areas would be less for this alternative because no sweeping of limestone or other clean stone would be allowed. However, the impact to the benthic community in the deeper areas of the Lakes would be the same as those predicted for the Proposed Action.

4.6.3.3 Benthic Community Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under this alternative, there would be long term and indirect insignificant impacts to the benthic community. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.6.3.4 Benthic Community Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The shoreside DCR control measure alternative is expected to produce long term and indirect insignificant impacts to the benthic community. The impacts would be very similar in type and intensity to the impacts from DCR control measures on ships.

4.6.3.5 Benthic Community Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to the benthic community. As discussed above, it could take up to 10 years of no DCR sweeping for the natural lake sedimentation to bury the historically deposited DCR, thus there could be residual impact to the benthic community over that time.

4.6.4 Fish and Other Pelagic/Planktonic Organisms

Fish and other pelagic/planktonic organisms are those found in the open water areas of the Great Lakes. Impacts to this resource were evaluated by considering some of the measures used to evaluate impacts to water quality, as described in Section 4.5, and by using the results of laboratory toxicity studies conducted with simulated slurries of DCR from decks or sump material. The following criteria were used to assign a level of impact to each alternative.

No Impact

An alternative was considered to have no impact to fish and other pelagic/planktonic organisms if DCR were not swept under the alternative or if all of the following conditions were met under an alternative that involves the sweeping of DCR:

- No chemicals attributable to DCR were predicted to occur in the water column, even in the mixing zone, at concentrations greater than the GLI chronic screening values for surface water or, where GLI values were not available, other chronic screening values.
- No depletion of dissolved oxygen was predicted to occur outside the DCR exclusion areas, even in the mixing zone.
- No adverse effects on the survival or growth of test organisms exposed to simulated slurries of DCR or sump material were found (based on statistical analyses of laboratory test results).

Insignificant Impact

An alternative was considered to have an insignificant impact to fish and other pelagic/planktonic organisms if all of the following conditions were met:

- One or more chemicals attributable to DCR were predicted to occur in the water column in the DCR discharge mixing zone at concentrations greater than GLI chronic screening values but less than GLI acute screening values.
- No chemicals attributable to DCR were predicted to occur in the water column outside of the mixing zone at concentrations greater than the GLI chronic screening values.
- No measurable depletion of dissolved oxygen was predicted to occur.
- No adverse effects were found on the survival or growth of test organisms (based on statistical analysis of laboratory test results) exposed to simulated slurries of DCR or sump material at dilutions equivalent to those predicted to occur in the DCR discharge mixing zones.

Significant Impact

An alternative was considered to have a significant impact if any of the following conditions were met:

- One or more chemicals attributable to DCR were predicted to occur in the water column outside the DCR discharge mixing zone at concentrations greater than GLI chronic screening values.
- One or more chemicals attributable to DCR were predicted to occur in the DCR discharge mixing zone at concentrations greater than GLI acute screening values.
- Depletion of dissolved oxygen was predicted to occur in the DCR discharge mixing zone to the extent that concentrations could be less than 1 mg/L.
- Adverse effects were found to the survival or growth of test organisms exposed to simulated slurries of DCR or sump material at dilutions equivalent to those predicted to occur in the DCR discharge mixing zones (based on statistical analyses of laboratory test results).

4.6.4.1 Fish and Other Pelagic/Planktonic Organisms Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no long term, short term, direct or indirect impacts to the fish and other pelagic/planktonic organisms. As described in Section 4.5, no chemicals attributable to DCR were predicted to occur in the water column, even in the mixing zone, at concentrations greater than the GLI chronic screening values for surface water or—where GLI values were not available—other chronic screening values, and no depletion of dissolved oxygen was predicted to occur outside the DCR exclusion areas, even in the mixing zone. As described in Appendix H, significant adverse effects on the survival or growth of test organisms were not observed when exposed to simulated slurries of DCR or sump material at the most realistic dilution scenario.

4.6.4.2 Fish and Other Pelagic/Planktonic Organisms Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to fish and other pelagic/planktonic organisms under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.6.4.3 Fish and Other Pelagic/Planktonic Organisms Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct or indirect impacts to fish and other pelagic/planktonic organisms from the control measures on ships alternative. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.6.4.4 Fish and Other Pelagic/Planktonic Organisms Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The fish and other pelagic/planktonic organisms' impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.6.4.5 Fish and Other Pelagic/Planktonic Organisms Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to fish and other pelagic/planktonic organisms.

4.6.5 Invasive Species

Invasive species, such as the zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*), have become a significant problem in the Great Lakes. The potential for DCR to exacerbate this problem by providing new or enhanced habitat for the species was evaluated. No potential effects on any invasive species except zebra and quagga mussels were identified. Impacts related to invasive species were evaluated as follows.

No Impact

If no DCR sweepings were to occur under the alternative, then no impact would be expected. If sweeping occurred under the alternative, but invasive mussel species did not attach preferentially (compared to native soft sediment) to DCR when it is present at anticipated maximum densities and depths on the lake bottom, then no impact would be expected. Additionally, if mussel distribution is limited by factors other than substrate or if maximum mussel population capacity is already achieved, then no impact would be expected.

Insignificant Impact

An alternative was considered to have an insignificant impact if laboratory studies showed that these invasive mussel species can attach to DCR when it is present on the lake bottom at anticipated depths and maximum densities, but attachment is less than 10 percent greater than the attachment observed on native soft sediment. The less-than-10-percent threshold was chosen here, as for other resource areas, based on expert opinion and because it is an increase that can be measured. Also, the threshold is intended to represent an increase in mussel density but not an increase that would have measurable, immediate, and ecosystem-level impacts.

Significant Impact

A significant impact would be expected for an alternative if laboratory studies showed that the mussel species can attach to DCR and that the proportion that attached to the DCR present at anticipated depth and density was more than 10 percent greater than the level of attachment observed on native soft sediment. This greater-than-10-percent threshold was selected because such an increase could have immediate and ecosystem-level impacts.

4.6.5.1 Invasive Species Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Lake Erie, Lake Ontario, and Lake Superior would experience no long term, short term, direct or indirect impact from invasive mussels under the Proposed Action alternative. Invasive mussels are considered ubiquitous in Lake Erie (Ciborowski, 2007) and Lake Ontario (Maher, 1999). As shown in Figure 4-1 for the quagga mussel, which is increasingly more abundant than the zebra mussel, the central basin area is the only large region of Lake Erie that is not highly colonized.

This is a result of periodic summer anoxia. DCR sweeping would not affect this condition in Lake Erie; thus no impact on mussels in Lake Erie is expected. Lake Ontario exhibits a similarly high existing density of mussels. Thus no impact on mussels in Lake Ontario is anticipated. Conversely, there is no established *Dreissena* population in Lake Superior currently, most likely as a result of low calcium levels outside of the tolerance range of these species (Appendix Q; Jenson, 2007; AP, 2007). DCR sweeping would not affect this condition in Lake Superior; thus no impact on mussels in Lake Superior is expected (Jenson, 2007; AP, 2007). Since the sweeping of DCR would not alter any of these conditions, the present mussel distribution and density in these lakes is not expected to change and there would be no impact.

While the conclusions are not definitive, available data indicate that mussel populations in portions of Lake Huron and Lake Michigan (Figure 4-2) have not reached maximum capacity and substrate may be a limiting factor, as discussed in Appendix Q. Thus, the remaining impact discussion of invasive species is in reference to Lakes Huron and Michigan.

Under the Proposed Action alternative, there would be insignificant adverse long term and indirect impacts in Lakes Huron and Michigan for invasive species. The impacts are indirect because they result from the direct impact on the physical structure of the sediment resulting from the addition of DCR. Laboratory studies have shown that these invasive mussel species can attach to DCR when it is present on the lake bottom at anticipated depths and maximum densities, but attachment is less than 10 percent greater than the attachment observed on native soft sediment. Thus an insignificant rather than significant impact is predicted.

As described in Appendix Q, these invasive mussels show a stronger attachment preference to DCR than to native soft sediment, even when the DCR is covered by a thin layer of native material. However, as described in the Appendix P and presented in Figure 4-3, adult dreissenid attachment is generally limited by an increasing depth of overlying sediment, and adults will penetrate sediment to only approximately 7 mm. Therefore, taconite and other DCR would be available, at least initially, for attachment, as this was the measured depth of DCR penetration (Appendix Q). Accordingly, there is the potential for invasive mussel habitat to be improved by deposition of DCR, with the potential habitat improvement being greater at greater DCR density.

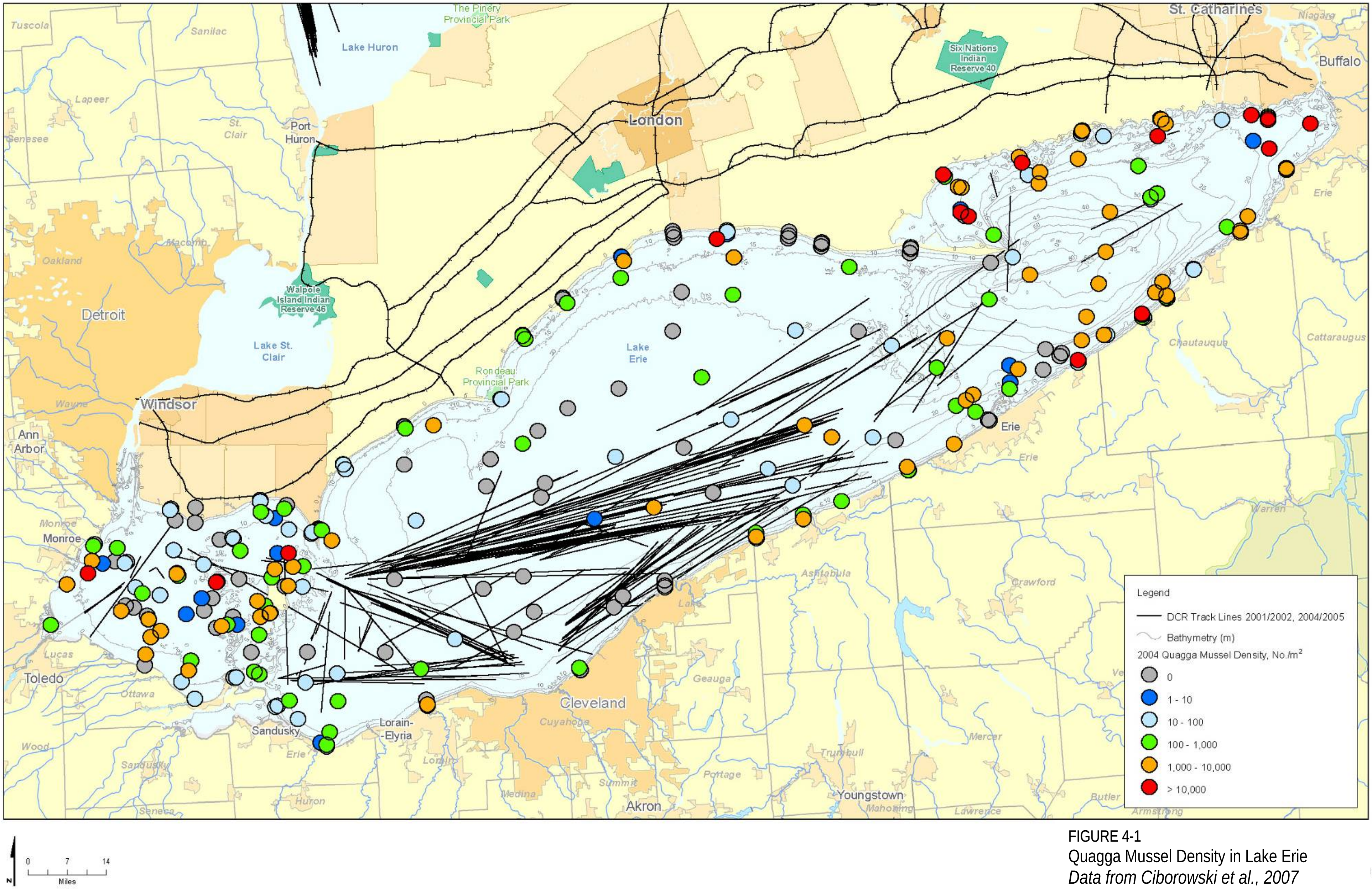


FIGURE 4-1
Quagga Mussel Density in Lake Erie
Data from Ciborowski et al., 2007

CH2MHILL

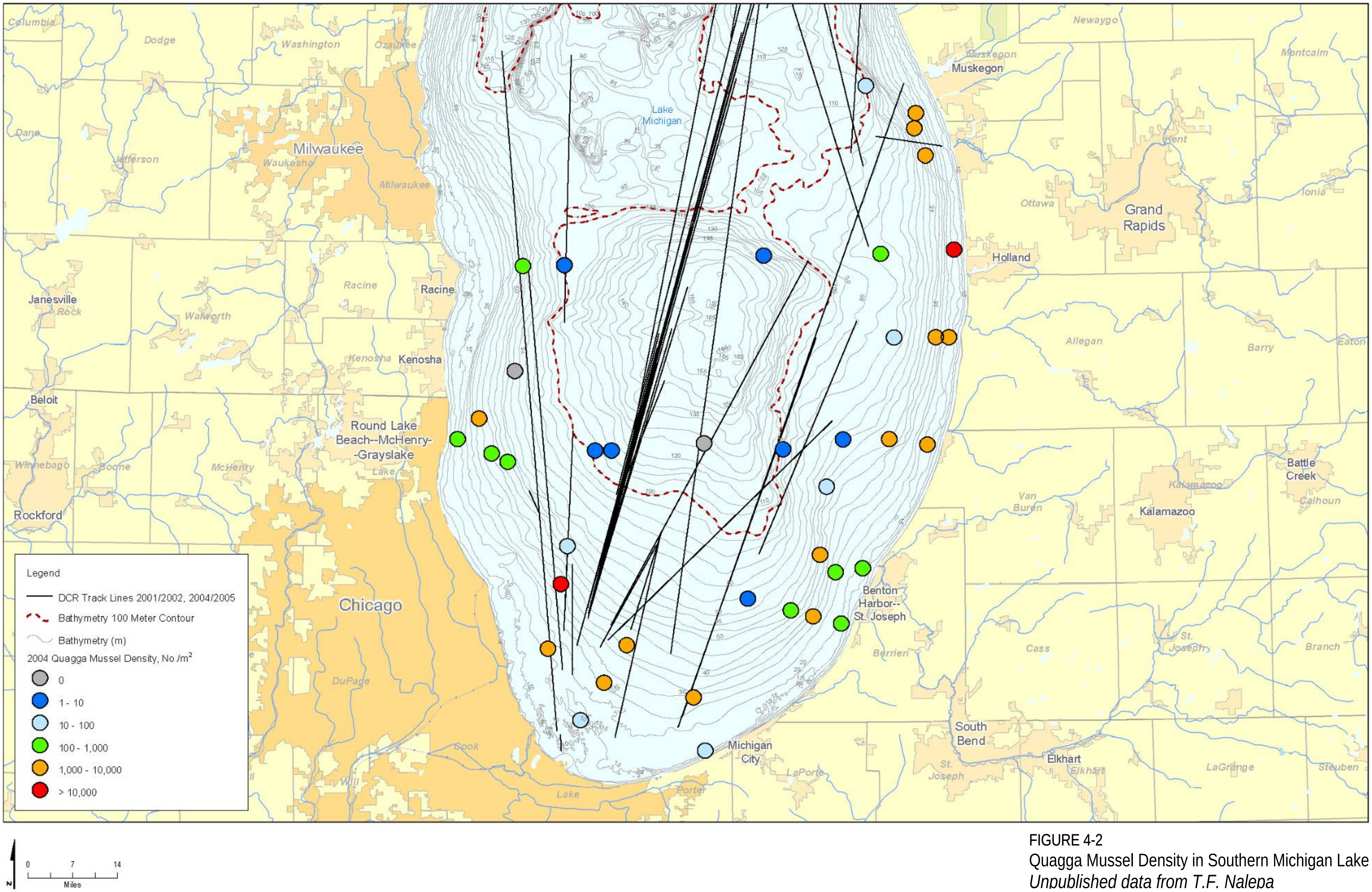
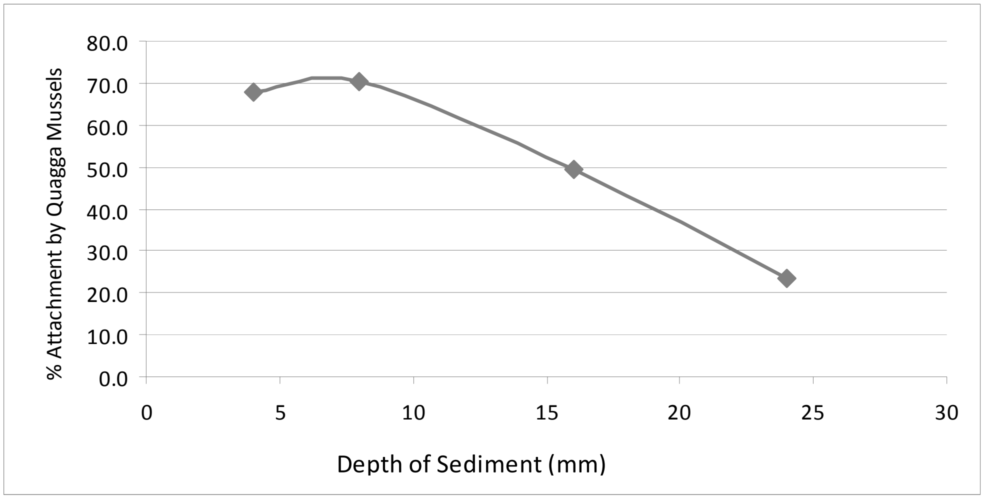


FIGURE 4-2
Quagga Mussel Density in Southern Michigan Lake
Unpublished data from T.F. Nalepa

CH2MHILL

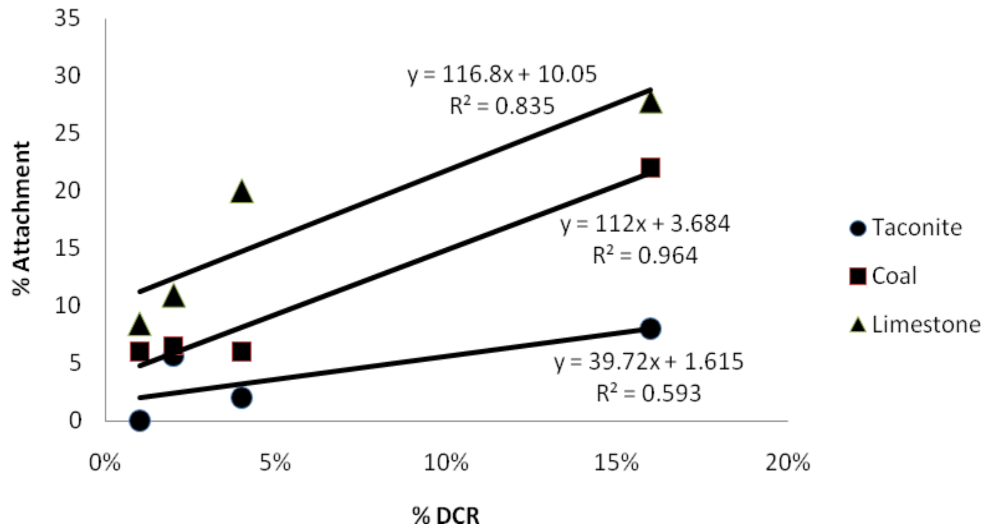
FIGURE 4-3
Attachment Success of Quagga Mussels to DCR (Taconite) Through Overlying Sediment



The initial tests were conducted at a density of DCR much higher than what occurs even in areas of the Great Lakes with the greatest rate of DCR sweeping. As documented in Appendix M, in areas of high DCR sweeping, the annual DCR discharge rate represents only approximately 0.2 percent of the natural annual sediment deposition rate. Using the relationship of density of DCR to mussel attachment derived from laboratory experiments (Appendix Q) and presented in Figure 4-4, at 0.2 percent DCR, the quagga mussel percent attachment would range from 2 percent to 10 percent. (Note that the highest rate is most likely less than 10 percent, because for limestone diluted to 1 percent, which was the lowest level that could be measured, the average percent attachment was 8 percent). Based on these results, there is the potential for mussel density to increase in areas having a high rate of DCR sweeping, and DCR sweepings may have contributed to the current condition. However, this potential is limited to areas that are not already fully populated with mussels and that have no other limiting factors, such as low calcium levels or deep water depths. Since the potential for increased mussel attachment from high rates of DCR sweeping is only in limited and small areas, measurable, immediate, and ecosystem-level impacts from current practices and future practices under the Proposed Action alternative are unlikely.

Assuming the factors that currently limit the expansion of mussel population do not change, there would be at most only small changes from the current condition in Lakes Huron and Michigan under the Proposed Action alternative. If these changes were to occur, they are not expected in the short term, are likely only over the long term, and may occur only if other limiting factors are removed. However, there may be some areas such as, for example, the open water east of Chicago (Figure 4-2), where substrate may be the only factor limiting colonization by quagga mussels. Any additional hard substrate to these areas may promote increased *Dreissena* colonization, but the size of these areas is very small relative to the total area that is already heavily populated. Expansion of the population to these areas is unlikely to have additional ecosystem-level impacts.

FIGURE 4-4
Results of Quagga Mussel Attachment Study for Three DCR Materials



4.6.5.2 Invasive Species Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

The impact of the modified exclusion areas alternative would be the same as for the Proposed Action in Lakes Erie, Ontario, and Superior; no long term, short term, direct or indirect impact. Similarly, the impacts from this alternative would be the same as for the Proposed Action in the off shore waters of Lakes Michigan and Huron; there would be insignificant long term and indirect adverse impacts for invasive species.

In at least some near shore areas (within 3 statute miles) the impact on invasive species could be markedly less than for the Proposed Action. The elimination of limestone and clean stone from shallow areas may have a greater impact on invasive species. As described in Appendix Q, quagga mussel attachment success is higher for limestone than for other DCR types, and the shallow water areas protected in the modified exclusion areas are preferred habitat areas for invasive mussels. By reducing the amount of hard substrate available for attachment, some decrease in mussel density could be expected in these shallow water areas, but the change would not be realized in the short term. Also, these areas are already heavily populated and the elimination of additional substrate is not likely to reduce the level of impact (insignificant and adverse in Lakes Michigan and Huron and no impacts in other Lakes) as a result of lower mussel densities.

4.6.5.3 Invasive Species Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

The impacts of this alternative would be very similar to those predicted for the Proposed Action; no impact in Lakes Erie, Ontario and Superior and insignificant long term indirect adverse impacts in Lakes Michigan and Huron. The impacts would be slightly reduced because up to possibly 40 percent less DCR would be swept. For invasive species in Lakes Michigan and Huron, a 40 percent reduction of DCR from areas that are substrate-limited and have no other factors limiting the colonization of dreissenids may decrease mussel density in those areas. However, the size of these areas is small relative to the total area already heavily populated. The reduction is not sufficient to warrant a change in the insignificant level of impact predicted for these lakes.

4.6.5.4 Invasive Species Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The invasive species impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts in Lakes Erie, Ontario and Superior and long term indirect insignificant adverse impacts in Lakes Michigan and Huron.

4.6.5.5 Invasive Species Impacts of No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to invasive species. However, it could take 10 years or more for natural lake sedimentation to bury the historically deposited DCR, potentially rendering it a less viable habitat for invasive mussels. Also, where there are already established mussels, the live and spent shells could form suitable substrate and the cessation of DCR sweeping would not change the existing invasive species density or distribution.

4.6.6 Waterfowl

Some species of waterfowl feed on benthic organisms at depths that could expose them to chemicals in DCR or to chemicals that have accumulated in the tissue of benthic organisms in DCR sweeping areas. Impacts related to waterfowl were evaluated as follows.

No Impact

An alternative was considered to have no impact to waterfowl if no DCR were swept under the alternative or if chemicals attributable to DCR were not found in the tissues of benthic organisms collected from outside the exclusion areas at levels above those in organisms collected from reference areas. Such a finding would indicate that the chemicals in the DCR are not bioavailable and are not accumulating in the food chain.

Insignificant Impact

An alternative was considered to have an insignificant impact to waterfowl if chemicals attributable to the DCR were found in the tissue of benthic organisms at levels above those in organisms collected from reference areas, but below levels likely to cause adverse effects on the survival, growth, or reproduction of waterfowl that feed on them (as determined by risk estimates from food chain modeling).

Significant Impact

A significant impact was expected for an alternative if chemicals attributable to DCR were found in the tissue of benthic organisms at levels above those in the tissue of benthic organisms collected from reference areas and at levels likely to cause adverse effects on the survival, growth, or reproduction of waterfowl that feed on them.

4.6.6.1 Waterfowl Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action alternative, there would be no long term, short term, direct or indirect impacts to waterfowl from DCR sweeping. As described in Section 4.6.3.1, chemicals in the tissues of benthic organisms from DCR sweeping areas are at levels similar to those in the tissue of benthic organisms from reference areas; similar results are expected for pelagic fish and planktonic organisms. This indicates that the chemicals in the DCR are not bioavailable and are not accumulating in the food chain.

4.6.6.2 Waterfowl of Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Impacts to waterfowl under this alternative would be the same as those predicted for the Proposed Action: there would be no long term, short term, direct or indirect impacts.

4.6.6.3 Waterfowl Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

There would be no long term, short term, direct or indirect impacts to waterfowl from the control measures on ships alternative. The impacts would be very similar to those predicted for the Proposed Action but slightly reduced because up to possibly 40 percent less DCR would be swept. As noted above there is uncertainty associated with this prediction and the reduction can not be accurately attributed to individual control measures.

4.6.6.4 Waterfowl Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The waterfowl impacts for this alternative would be the same as for Proposed Action with DCR Control Measures on Ships: there would be no long term, short term, direct or indirect impacts.

4.6.6.5 Waterfowl Impacts of Alternative 1—No Action

Since there would be no sweeping of DCR under the No Action alternative, there would be no long term, short term, direct or indirect impacts to waterfowl.

4.6.7 Biological Resource Impact Summary

As described above, the only biological resource impacts are insignificant impacts to benthic community structure, protected and sensitive areas, and, in Lakes Michigan and Huron only, invasive species. The impacts are similar for benthic community structure and invasive species for all alternatives except for No Action, where there is no impact. There are no impacts on protected and sensitive areas predicted for No Action. There would be a lower degree of impact on protected and sensitive areas from the Modified Exclusion Areas alternative than for the other alternatives. Only one area is affected under the Modified Exclusion Area alternative but five under the other alternatives. These impacts are summarized below and in Table 4-6.

The impact on benthic community structure is indirect because it results from change in physical structure caused by the sweeping of DCR rather than directly from DCR. It is long term because the change in physical structure, which causes the change in community structure, persists as long as DCR sweeping occurs. In fact, the impact would persist up to 10 years after any DCR sweeping is terminated, until the DCR was buried by natural sedimentation. The insignificant adverse effects to benthic community structure cannot be avoided. As discussed in Chapter 6, the impacts can be mitigated by reducing the amount of DCR swept, but, even with mitigation, all alternatives (except No Action) result in sweeping and deposition in the Lake sediments of DCR and the resulting change in benthic community structure is unavoidable. There is no consumption, significant change, or irreversible commitment of resources related to community structure predicted for any of the alternatives.

TABLE 4-6
Comparison of Alternatives Based on Significance Criteria: Biological Resources

Resource	No Action	Proposed Action	Modified Exclusion Areas	DCR Control Measures	
				Ship	Shore
Special-status species	○	○	○	○	○
Protected and sensitive areas	○	◍	◌	◍	◍
Benthic community	○	◍	◍	◍	◍
Fish, other pelagic organisms	○	○	○	○	○
Invasive species—Lake Ontario, Lake Erie, Lake Superior	○	○	○	○	○
Invasive species—Lake Michigan, Lake Huron	○	◍	◍	◍	◍
Waterfowl	○	○	○	○	○

○ No adverse impact.
◌ Impact, but impact less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

The impact for invasive species in Lakes Michigan and Huron is indirect because it results from change in physical structure caused by the presence of DCR rather than directly from DCR sweeping. It is long term because the change in physical structure, which causes the potential increase in invasive mussel species density and distribution in the two Lakes, persists as long as DCR sweeping occurs. In fact the impact could persist indefinitely because mussels that colonize DCR particles could form suitable substrate for future generations of mussels.

The insignificant effects with respect to invasive mussels in Lakes Michigan and Huron cannot be avoided. As discussed in Chapter 6, the impacts can be mitigated by reducing the amount of DCR swept, but even with mitigation, all alternatives (except No Action) result in sweeping and deposition in the lake sediments of DCR. This in turn provides suitable substrate in at least some areas where the substrate is not conducive to mussel attachment. Although high densities of invasive mussels could decrease long-term productivity, the minor potential increase in mussel density and limited area affected estimated to result from even the maximum rate of DCR sweeping is not expected to alter long-term productivity. Similarly, the minor potential increases in mussel density are not likely to irreversibly or irretrievably affect any resources.

There is a degree of uncertainty in predicting the impact for invasive mussels. The Coast Guard has taken into account the best available science and expert opinions in determining the impacts of the alternatives.

4.7 Socioeconomic Resources

Socioeconomic resources considered for this DEIS include economic systems, consisting of the waterborne dry bulk carrier industry and other industries dependent on Great Lakes waterborne dry bulk shipping, and associated costs; water-dependent infrastructure consisting of port facilities, commercial shipping lanes; fishing, and associated costs; and environmental justice. The resources were selected for their possible connection to DCR. Socioeconomic resources that were eliminated from consideration are listed in Sections 3.2.6 and 3.2.8–3.2.11.

4.7.1 Economic Systems

The evaluation of impacts to economic systems focused on the effects of each alternative on the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping (shippers and receivers), and the relative costs to implement and carry out control measures. These impacts are summarized below and in Table 4-7. We have made an initial determination of the costs. Any benefits would be a function of the volume of currently discharged material that could be captured. Since our current data on the volume of material being discharged is based only on partial and voluntarily reported information, we have not yet been able to estimate benefits. However, under the recordkeeping alternatives, more complete and reliable information on discharge volume would be recorded; thus benefits could be calculated.

The terms "insignificant" and "significant" are used below and in the remainder of the DEIS to be consistent with the impact criteria of other resource areas in this document. It is not meant to denote "economic significance" as defined in Executive Order 12866.

No Impact

The alternative would not affect the efficiency of waterborne shipping, or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be negligible. These costs could be in the range up to $100,000 for the U.S. Great Lakes dry bulk carrier fleet.

Insignificant Impact

The alternative would have a minor effect on the efficiency of waterborne shipping, or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be minor. These costs could be in the scale range of $100,000 - $500,000, or closer to the negligible range of No Impact, rather than the major costs of Significant Impact.

Significant Impact

The alternative would have a major effect on the efficiency of waterborne shipping, or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be major. These costs could be in the range of $500,000 - $100,000,000 for the U.S. Great Lakes dry bulk carrier fleet.

4.7.1.1 Economic Systems Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action physical DCR management practices would remain essentially the same, with the addition of recordkeeping requirements. Thus, future conditions and impacts would be very similar to those of existing DCR operations.

There would be no impacts on the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping because the estimated economic costs would be negligible, consisting of recordkeeping by the shipping companies. There is very little cost involved with requiring vessels to keep records of their bulk dry cargo residue (DCR) sweeping and making those records available to inspectors. Many vessel operators already record this information voluntarily. The total annual cost for the U.S. Great Lakes dry bulk carrier industry (not per ship) is estimated to be approximately $70,800, for all Canadian shippers, approximately $19,500, and for non-Canadian foreign shippers, approximately $14,600. The figures are from the “Regulatory Analysis” contained in the Notice of Proposed Rulemaking (NPRM) that announces the public availability of this DEIS. The impacts would be direct and would be long-term in light of the historical practice.

4.7.1.2 Economic Systems Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under the Proposed Action with Modified Exclusion Areas alternative, impacts to waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping are uncertain due to lack of information on possible vessel route changes to avoid exclusion areas to sweep. Although definitive economic costs are not available, preliminary costs are provided in Section 2.4.5, and are considered to be minor. Thus the overall impact would be insignificant. The impacts would be direct and would be long-term because the impact would persist years after the action was begun.

4.7.1.3 Economic Systems Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under the Proposed Action with DCR Control Measures on Ships alternative, impacts would be similar to the Proposed Action. Impacts to efficiencies of waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping from DCR sweeping could be slightly greater than under the Proposed Action, meaning there would still be no impact.

Estimated economic costs to shipping would be higher, consisting of recordkeeping, and installation and operation of control measures for those ships that did not already have them. Definitive economic costs are not available for shipboard control measures, but preliminary costs are provided in Table 2-4. The latter costs would cause the effects on economic systems to be classified as insignificant impacts because they are anticipated to be minor. The impacts would primarily be direct, but could be indirect as transfer costs if some of the costs to shipping were passed (transferred) to dependent industries. Impacts would be short term for initial capital expenditures and long-term for operation and maintenance.

4.7.1.4 Economic Systems Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The impacts of the Proposed Action with Shoreside DCR Control Measures alternative would be similar to those of the Proposed Action with DCR Control Measures on Ships alternative. In addition to the recordkeeping requirements, estimated economic costs to shipping might be higher, depending on how much of any additional costs to shore facilities could be transferred to ships. Any costs to shore facilities are anticipated to be minor, so there is insignificant impact. The impacts would primarily be direct, but could be indirect if some of the costs for shoreside facilities shipping were transferred to ships. As with recordkeeping, impacts would be long-term because the impact would persist years after the action was begun.

4.7.1.5 Economic Systems Impacts of Alternative 1—No Action

Under the No Action alternative, impacts to efficiencies of the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping would be greater than those for the other alternatives. This alternative differs from the alternatives with control measures in that No Action would require complete elimination of DCR sweeping to the Lakes, while control measures are meant to reduce amounts swept. The methods required to achieve no discharge are considerably more stringent and costly than those for the control measure alternatives, although it may be a matter of degree. Potential efficiency losses and economic costs to shipping could be major for installation and operation of measures to prevent any DCR sweeping, causing the impacts to economic systems to be classified as significant. Disruption to industries dependent on Great Lakes waterborne dry bulk shipping, including commodity producers and commodity users, could be major (significant impact) from the loss of efficiency and increase in costs by waterborne dry bulk shipping. To the extent that ships could transfer costs to dependent industries, their costs could be higher.

The estimated costs to ships and facilities for the No Action Alternative are an initial cost of approximately $51,800,000, with an annually recurring cost of $35,700,000. Most of those costs would be incurred by the U.S. Great Lakes dry bulk carrier fleet. The initial costs are capital, installation, and operations and maintenance costs for collection of DCR, shipboard systems that convey washwater from ships to shore facilities for pretreatment, and sewer usage charges for disposing of washwater to a municipal wastewater system. Also included are the labor cost to do sweepings and washdowns and the additional time (delay) at the facility to conduct them (NPRM—Regulatory Analysis).

The impacts would primarily be direct, but could be indirect as transfer costs if some of the costs were passed to shippers and end users. Impacts would be short term for initial capital expenditures and impacts to efficiencies, and long-term for operation and maintenance, and for efficiency changes that could not be overcome.

4.7.2 Water-Dependent Infrastructure

The evaluation of impacts to water-dependent infrastructure focused on the effects of the alternatives on port facilities and commercial shipping lanes and the relative costs to implement and carry out control measures. These impacts are summarized below and in Table 4-8.

No Impact

The alternative would not affect the efficiency of port facilities or commercial shipping lanes. The estimated economic costs to port facilities or commercial shipping lanes would be negligible.

Insignificant Impact

The alternative would have a minor effect on the efficiency of port facilities or commercial shipping lanes. The estimated economic costs to commercial shipping lanes or port facilities would be minor.

Significant Impact

The alternative would have a major effect on the efficiency of port facilities or commercial shipping lanes. The estimated economic costs to commercial shipping lanes or port facilities would be major.

4.7.2.1 Water-Dependent Infrastructure Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no impacts on commercial shipping lanes and port facilities because these elements would not be affected by recordkeeping requirements. Therefore, no economic costs would be imposed by the alternative.

4.7.2.2 Water-Dependent Infrastructure Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under the Proposed Action with Modified Exclusion Areas alternative, impacts to commercial shipping lanes and port facilities would be similar to the Proposed Action, and are considered no impact.

4.7.2.3 Water-Dependent Infrastructure Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under the Proposed Action with DCR Control Measures on Ships alternative, impacts to commercial shipping lanes and port facilities would be similar to the Proposed Action, i.e., impacts to efficiencies and costs of water-dependent infrastructure from DCR sweeping would be no impact.

4.7.2.4 Water-Dependent Infrastructure Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The impacts of the Proposed Action with Shoreside DCR Control Measures alternative to commercial shipping lanes and port facilities would be similar to those of economic systems—waterborne dry bulk shipping for the Proposed Action with DCR Control Measures on Ships alternative - insignificant impact. Estimated economic costs to port facilities would be higher than for the Proposed Action, for those facilities that had to install and operate new control measures, although some of the economic costs could possibly be transferred to ships. Definitive economic costs are not available for shoreside control measures, but preliminary costs are provided in Table 2-6. Costs are anticipated to be minor, so there is insignificant impact. The cost impacts would be direct. Impacts would be short term for initial capital expenditures and long-term for operation and maintenance.

4.7.2.5 Water-Dependent Infrastructure Impacts of Alternative 1—No Action

Under the No Action alternative, impacts to port facilities would be greater than those for the other alternatives. Potential economic costs to shore facilities could be major for installation and operation of measures to prevent any DCR sweeping, causing the impacts to water-dependent infrastructure to be classified as significant. As stated for economic systems, this alternative differs from the shoreside control measure alternative because the methods required to achieve no discharge are considerably more stringent and costlier. The impacts would primarily be direct. It is possible that some of these costs could be transferred to ships. Impacts would be short term for initial capital expenditures and impacts to efficiencies, and long-term for operation and maintenance, and for efficiency changes that couldn't be overcome. There would be no impact to commercial shipping lanes.

Although the fleet would incur the bulk of the costs under this alternative, the costs to port facilities would also be significant. The initial costs are capital, installation, and operations and maintenance costs for shoreside systems to pretreat washwater from ships and convey it to the municipal wastewater system (NPRM—Regulatory Analysis).

4.7.3 Fishing

The evaluation of impacts for recreational and commercial fishing is the same as that for fish and other pelagic/planktonic organisms, in Section 4.6.4. These impacts are summarized below and in Table 4-9.

4.7.3.1 Fishing Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no impacts to the fish and other pelagic/planktonic organisms, as described in Section 4.6.4.1.

4.7.3.2 Fishing Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under the Proposed Action with Modified Exclusion Areas alternative, impacts to fishing would essentially be the same as the current state - no impact. There could be slightly less effect on fish and other pelagic/planktonic organisms, because the exclusion area modifications could move sweeping more offshore, further away from most spawning and other sensitive areas.

4.7.3.3 Fishing Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under the Proposed Action with DCR Control Measures on Ships alternative there would be no impact. Per Section 4.6.4.3, since no impact to fish and other pelagic/planktonic organisms was predicted under the Proposed Action, the no impact conclusion would also apply with a reduction of DCR sweepings.

4.7.3.4 Fishing Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The effect of the Proposed Action with Shoreside DCR Control Measures alternative would be no impact to fishing from sediment and water quality.

4.7.3.5 Fishing Impacts of Alternative 1—No Action

Since no impact to fish and other pelagic/planktonic organisms was predicted under the Proposed Action, this level would not change with the elimination of DCR discharge under No Action, per Section 4.6.4.5, so the effects on fishing would still be no impact.

4.7.4 Environmental Justice

The evaluation of impacts relating to environmental justice focused on the impacts from DCR sweepings on minority and low-income populations relating to disproportionately high and adverse human health or environmental effects. The evaluation of impacts relates closely to sediment chemistry in Section 4.4, water quality in Section 4.5, and biological resources in Section 4.6. These impacts are summarized below and in Table 4-10.

No Impact

An alternative was considered to have no impact if no DCR sweepings were to occur, or minority and/or low-income persons or populations were not present or their means of subsistence were not in areas within the possible influence of DCR sweeping s (fishing), or DCR sweeping did occur in an area with minority and/or low-income persons or populations but there was no interaction between the two.

Insignificant Impact

An alternative was considered to have an insignificant impact if minority and/or low-income persons or populations were present or their means of subsistence occurred in areas where sweeping would be allowed, but the alternative would not cause disproportionately high and adverse human health or environmental effects, or not adversely affect their means of subsistence if those means were in areas within the possible influence of DCR sweeping (fishing).

Significant Impact

A significant impact could be expected if minority and/or low-income persons or populations were present or if their means of subsistence were in areas within the possible influence of DCR sweeping and the alternative could cause disproportionately high and adverse human health or environmental effects on those persons or populations.

4.7.4.1 Environmental Justice Impacts of Alternative 2—Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, there would be no environmental justice impacts on minority and/or low-income persons or populations because they would not be present in sweeping areas. If their means of subsistence included fishing, that would not be impacted, as demonstrated in Section 4.6.4.1. Water quality impacts with regard to environmental justice are not expected because future water quality conditions would be very similar to existing conditions, as described in Chapter 3, and the impacts would be very similar to the impact of existing operations, described in Appendix I. Impacts would be long-term in light of the historical practice.

4.7.4.2 Environmental Justice Impacts of Alternative 3—Proposed Action with Modified Exclusion Areas

Under the modified exclusion area alternative, as with the Proposed Action, there would be no environmental justice impacts.

4.7.4.3 Environmental Justice Impacts of Alternative 4—Proposed Action with DCR Control Measures on Ships

Under the Proposed Action with DCR Control Measures on Ships alternative, there would still be no impact on environmental justice from sediment, water quality, and biological resources, so the effect on environmental justice would also remain no impact, and it would be long-term because the impact would persist several years after the action was begun.

4.7.4.4 Environmental Justice Impacts of Alternative 5—Proposed Action with Shoreside DCR Control Measures

The effects of the Proposed Action with Shoreside DCR Control Measures alternative would still be no impact on environmental justice from sediment, water quality, and biological resources, so the effect on environmental justice would also remain no impact, and it would be long-term because the impact would persist several years after the action was begun.

4.7.4.5 Environmental Justice Impacts of Alternative 1—No Action

There would be no impact on environmental justice from sediment, water quality, and biological resources from the No Action alternative, so the effect on environmental justice would also remain no impact. Impacts would be long-term in light of the historical practice.

4.7.5 Socioeconomic Resource Impact Summary

As described above, the notable socioeconomic resource effects are a significant impact to economic systems (shipping) and possibly to water-dependent infrastructure (port facilities) due to the potential economic costs to prevent any sweeping of DCR into the Great Lakes under the No Action alternative. There may significant impact to other resource categories as well. Similarly there is an insignificant impact on economic systems (shipping) and water-dependent infrastructure (port facilities) due to the potential costs of control measures for the Proposed Action with DCR Control Measures on Ships and the Proposed Action with Shoreside DCR Control Measures alternatives, again due to potential economic costs—in this case for the control measures. The non-cost impacts of the alternatives on socioeconomic resources are similar for each of the alternatives, and are all classified as no impact. The non-cost impacts are long term because the change in physical structure persists as long as DCR sweeping occurs, and the impact would persist several years after any DCR sweeping was terminated, until the DCR was buried by natural sedimentation.

The significant impact to shipping from estimated economic costs under the No Action alternative for measures to prevent any DCR sweeping cannot be avoided, unless the ships cease operations, and that would have an even greater economic cost impact. The situation is similar for the two alternatives that incorporate control measures, the insignificant impacts from economic costs could not be avoided by the ships and facilities that aren't already equipped, unless they cease operations. There is no consumption, significant change, or irreversible commitment of resource related to socioeconomic resources predicted for any of the alternatives.

TABLE 4-7
Comparison of Alternatives Based on Significance Criteria: Socioeconomic Resources

Resource	No Action	Proposed Action	Modified Exclusion Area	DCR Control Measures	
				Ship	Shore
Economic Systems—Dry bulk carrier industry	●	○	◍	◍	◍
Economic Systems—Industries dependent on Great Lakes waterborne dry bulk shipping	●	○	○	○	○
Water-Dependent Infrastructure—Commercial shipping lanes	○	○	○	○	○
Water-Dependent Infrastructure—Port facilities	●	○	○	○	◍
Recreational and commercial fishing	○	○	○	○	○
Environmental justice	○	○	○	○	○

○ No adverse impact.
◌ Impact, but impact less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

CHAPTER 5

Cumulative Impacts and Mitigation Measures

5.1 Scope of Cumulative-Impacts Analysis

Under NEPA, cumulative impacts must be considered in the assessment of a proposed action's potential impacts. For the purposes of NEPA, the CEQ regulations define a "cumulative impact" as:

> … the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time [40 CFR 1508.7].

In considering potential cumulative impacts associated with the Proposed Action for this Draft EIS, CEQ's (1997) guidance, *Considering Cumulative Effects under the National Environmental Policy Act,* was followed.

Typically, a cumulative-impacts analysis addresses the additive effects of existing activities in the affected area, a proposed action not yet implemented, and public and private plans that might occur in the future and affect resources. Cumulative impacts can result from similar activities that recur frequently, from activities occurring intensely in the same space, or from different kinds of activities affecting common environmental resources.

In the case of DCR, sweepings have occurred throughout the Great Lakes for a century and are likely to have decreased over time. In the 1970s, ships began being modernized, and DCR sweeping for a sampling of modernized ships were observed to have decreased relative to older ships, as described in Chapter 4 and Appendix O.

In 1993, with implementation of the IEP, DCR sweeping, while continuing to occur, were restricted to areas where environmental impacts were predicted to be the least. Sweeping areas were further modified with subsequent IEP revisions. In addition, voluntary recordkeeping was initiated, raising awareness among shipping companies of the quantity of incidental DCR they were sweeping. Evidence suggests that because of the heightened awareness, the costs associated with the sweeping of DCR, and ship improvements, DCR sweepings have continued to decrease. As discussed in Chapter 4, each of the alternatives under consideration would maintain or reduce DCR relative to existing conditions.

Because of the historic practice of DCR sweeping, the additive effect of DCR sweeping and other discharges or sources having a similar impact to the Great Lakes is most closely characterized by existing conditions under the IEP. In the sections that follow, the cumulative effect of each of the alternatives and other actions that might contribute impacts in the future is considered by resource category: sediments, water quality, and biological resources. This section focuses on actions that may be more likely to cause cumulative impacts (that is, actions or projects that would occur relatively close to the areas affected by DCR sweepings).

5.2 Identification of Past, Present, and Reasonably Foreseeable Future Actions

The approach to evaluating cumulative impacts for this DCR EIS differs from the approach used in many environmental evaluations. In most cases, the environmental evaluator is faced with predicting the changes that may occur because of the proposed action and then adding some estimate of change from other anticipated activities to the impacts of the proposed action. Adding predictions on top of predictions frequently produces a high degree of uncertainty.

In contrast, for the DCR evaluation, impacts of the Proposed Action (sweeping of DCR) can be measured directly because the Proposed Action has been in effect for decades. Thus, the prediction of Proposed Action impacts can be validated by measurements taken of conditions resulting from DCR sweeping at rates and locations very similar to those anticipated for the Proposed Action. Similarly, effects from other activities (for example, land-based runoff and discharges) have occurred simultaneously with DCR sweeping, and the interactions of these activities are measurable and do not require speculation. Thus Chapter 3 (Affected Environment) reflects the past cumulative impact of DCR activities that are very similar to those anticipated under the Proposed Action and other ongoing or anticipated activities that might cause additional stress.

Chapter 3 also provides insight into potential future cumulative impacts of the DCR alternatives. The types of potential future cumulative impacts are anticipated to be very similar to those measured for existing conditions because the same type of activities are anticipated in the future (both for DCR sweeping and other factors affecting water, sediment and biological resources). However, the intensity of the cumulative impacts is estimated to be less because there will be the same or reduced DCR sweeping under the alternatives. Also, there is a substantial positive trend in reducing stress to the Great Lakes from other sources, particularly the so-called “legacy” chemicals, e.g., PCBs and DDT, through stormwater controls, ongoing sediment remediation, etc. Other stresses to the biological community, however, are significant and include nutrient (phosphorus) dynamics, invasive species, food web disruptions, habitat alterations, and other chemicals of emerging concern. Thus, less stress and a lower intensity of cumulative Great Lakes system impacts from activities related to DCR sweeping are anticipated, although other significant and continuing stresses to the biological communities are expected.

As part of the State of the Lakes Ecosystem Conference conducted in 2006 by EPA and Environment Canada, the health of the Lakes is generally described as mixed with some areas rated as in poor health and some in good health (EPA and Environment Canada, 2007). Concentrations of some chemicals and chemical groups have declined markedly (PCBs and PAHs), with a reduction in the levels of toxic chemicals in air, water, biota, and sediments. However other chemicals remain a problem in locals regions, such as Areas of Concern. There is a substantial positive trend in reducing stress to the Great Lakes from other sources (stormwater controls, ongoing sediment remediation, etc.), although organic contaminants continue to enter the Great Lakes from indirect sources such as the atmosphere, agricultural runoff, and resuspension of contaminated sediments. Concentrations of nutrients, such as phosphorus, have decreased markedly in open waters as a result of private and governmental controls, which have had a positive effect on fisheries, although high concentrations are still measured in some nearshore areas and embayments. This has contributed to elevated levels of the nuisance algae, *Cladophora*.

Despite improvements in contaminants in the Great Lakes, many biological components remain stressed. Populations of native species at the base of the food chain, such as *Diporeia spp*, have continued to decline, coincident with the introduction and expansion of non-native mussel species. And although fish populations remain stressed, with active lake management efforts, trout species are improving in Lake Huron, and have recovered in Lake Superior so that stocking is no longer required.

Despite the mixed conditions report in the Great Lakes, active management activities including fisheries management and stocking, expansion of sustainable forestry practices that reduce soil and water quality impacts, habitat restoration activities, active management to prevent the introduction and spread of invasive species, and ongoing monitoring and assessment of lake conditions are expected to lower the intensity of cumulative Great Lakes system impacts.

5.2.1 Sediments

Under historic and current conditions, sediment loads to the Great Lakes are diffuse in origin and are generated from a variety of land and water practices. Agricultural land use, development activities, and mining, all of which expose the soil surface, contribute to the sediment found in runoff, which drains to tributary streams and ultimately to the Great Lakes. Other sediment sources include runoff from road surfaces, eroding stream channels, and dumping in or adjacent to water bodies. Atmospheric deposition of particulate material also is responsible for sediment contributions throughout the Great Lakes. Although most of the land-use-derived sediment load is deposited in nearshore areas of the Great Lakes, wind, currents, and other weather effects contribute to the mixing and transport of sediments throughout the Lakes. As described in Chapter 3, deposition of DCR sweepings is a minor component of the background deposition of sediment and organic material.

Foreseeable future conditions are based on trends in land use, development, land and water management, and regulatory conditions rather than on individual projects or development actions, because the sediment sources to the Great Lakes are so diffuse. Sediment from land use and development activities in the watershed will continue, but based on Federal and State regulations, particularly the increasing rigor in enforcing stormwater controls under CWA, there will be an ongoing emphasis on reducing nonpoint sources of sediment from agricultural activities, development, mining, and road surfaces. A continued emphasis is expected on managing peak stormwater flows and low-impact development patterns that reduce stormwater runoff and its associated pollutants. Managing peak flows will reduce stream degradation and erosion of stream channels, and thereby reduce sediment contributions to the Great Lakes. In addition, there is an ongoing EPA-sponsored program to address “legacy sediment contamination” issues in the Great Lakes. As this program proceeds, the impacts to sediments should be reduced with time.

5.2.2 Water Quality

As described in Chapter 3, water quality in the Great Lakes is affected by a variety of factors, including in-lake cycles, external inputs from point and nonpoint sources of pollution, and atmospheric deposition. Under historic and current conditions, no impact on water chemistry, dissolved oxygen, and nutrient enrichment because of the DCR sweeping has been observed or is predicted to occur.

As with sediment, foreseeable future conditions that might affect water quality are based on trends in land use, land and water management, and regulatory conditions rather than on individual projects or development actions, because all of these factors affect water quality to a much greater extent than individual projects. Also, the impacts that result from individual projects are controlled by the management and regulatory programs in place. Development will continue throughout the Great Lakes watershed, resulting in long-term contributions of water quality pollutants. However, in keeping with trends in evidence since passage of the CWA, in 1977, and subsequent amendments, point and nonpoint sources of pollution will continue to be regulated with a continuing emphasis on standards that are based on ecosystem health. Ongoing efforts to control toxic substances and address legacy contaminants and atmospheric sources of pollution also are expected to continue.

5.2.3 Biological Resources

As described in Chapter 3, biological resources have been affected by sediment, water quality, human activities, and interactions among biological communities. Under historic and current conditions, which include sweeping of DCR, changes have been observed in fisheries, benthic invertebrate populations, and invasive species.

Over the past 100 years, many native fish species have been lost because of overfishing, pollution, invasions by non-native species, and natural changes. The fishery has rebounded in recent years, however, and some native fish are making a comeback because of government-imposed fishing quotas, reductions in pollution, efforts in controlling invasive species, and habitat restoration projects, such as the creation of artificial reefs.

Over the last 10 years, benthic invertebrate populations have undergone major changes in nearshore and offshore regions of the Great Lakes. Although DCR sweeping has the potential to produce changes in the benthic community, most of these changes can be attributed to the widespread distribution and great abundances of the invasive dreissenid mussels.

Foreseeable future conditions that may affect biological resources will continue to be complex. Future conditions affecting sediment resources and water quality, as described above, have the potential to influence biological resources, as do future actions affecting the continued introduction, transport, and spread of invasive mussels. Similarly, changes in factors that currently limit mussels, such as temperature, food availability, water depth, substrate, temperature, dissolved oxygen levels, and calcium concentrations, could change the current mussel density and distribution.

5.2.4 Socioeconomic Resources

Evaluation of impacts to economic systems and water-dependent infrastructure focused primarily on the trends of the industries and the relative costs to implement and carry out DCR control measures. The waterborne dry bulk carrier industry and industries that depend on it have been in existence for approximately 200 years, evolving with changes in technology and demand for their goods and services. Volumes of commodities carried are prone to annual variability, but have generally been steady or rising moderately during the ten years prior to 2008, excepting iron ore which is more variable. There has been a decline in many of the user industries in the Great Lakes, including steel, manufacturing, and construction, while others such as transportation, agriculture, and energy have been steady or growing, influenced by increased global commodities demand. Other factors for the carriers are relative freight rates, transit times, and technological and operational changes in the other modes, and decrease in water depths which reduced vessels' overall cargo carrying efficiency. There has been very little recent shipbuilding of Great Lakes dry bulk carriers, most of that being conversions to integrated tug-barge units (MARAD 2005).

Foreseeable future conditions for Great Lakes waterborne bulk dry cargo and related industries are based on trends in technology, demand, competition, operating costs and even climate. Factors influencing commodities transported include a shifting from high-sulfur eastern coal, indigenous to the Great Lakes region, to cleaner-burning western coal, which is primarily shipped by rail. However, waterborne carriers think that coal is the commodity most likely to be captured from existing rail or truck carriage. The regional steel industry may not recover from its long-term decline, although there is increasing demand for iron ore by China and other growing economies. Again, there is currently some competition (modal substitution) from rail, with iron ore being the commodity most susceptible to capture from vessel traffic. Overall, Great Lakes carriers are optimistic about growth in historically dominant bulk cargoes, based on prospects for the continued regional importance of manufacturing, construction and utilities. There is also a potential for new Great Lakes bulk cargo trades such as iron ore briquettes, plastic pellets and scrubbing stone (MARAD 2005).

Foreseeable future conditions include government initiatives to boost short sea shipping, based on scale efficiencies in energy use and, hence, lower air emissions, when compared to rail and trucking. Regardless, fuel costs will continue to be a major expense for vessels, and bulk commodities are particularly sensitive to small changes in freight rates. Other long-term challenges include crew size and lower lake levels requiring dredging. Regarding capital investment, the trend toward integrated tug-barge units is projected to continue for the next generation of Great Lakes vessels, and they would be expected to incorporate the latest cargo handling control measures. Obviously, shipbuilding will be driven by demand and influenced by government subsidies. Public investment in related infrastructure is expected to go toward navigation locks, with private sector investment going to loading equipment, storage capacity and docks. Port facilities upgrades would also likely include the latest cargo handling control measures (MARAD, 2005; Allardice and Thorp, 1995). Warming trends may lengthen the shipping season, although there will still be periodic vessel and infrastructure (navigation locks) maintenance lay-up requirements.

Fishing is related to the biological resources discussion in Section 5.2.3. In addition, the commercial fishery in the region has been declining due to over-fishing, pollution (affecting habitat and fish toxicity to humans), habitat destruction, and introduction of invasive species (GLERL 2004). Aquaculture offers opportunities for raising fish for human consumption and for rebuilding or restoring depleted finfish stocks. Invasive species will continue to be a factor , with a trend of increasing control through standards, management and enforcement.

Factors associated with environmental justice are not expected to change, although the proportion of low income population may increase if the regional economy declines. Minority populations can be expected to remain at current levels or increase as a proportion of the total U.S. Great Lakes population. Minority and low-income populations are likely to live and work in inland or coastal areas of the Great Lakes, away from areas of DCR sweeping.

5.3 Assessment of Cumulative Impacts

5.3.1 Sediments

The Proposed Action (IEP as Coast Guard Regulation with Recordkeeping) would be a continuation of existing conditions with the addition of recordkeeping. The effect of the Proposed Action combined with foreseeable future actions emphasizing the control of point and nonpoint sources to sediments is expected to be similar, or perhaps slightly less intense than existing conditions (due to reduced stress from non-DCR sources, as summarized above), thus DCR sweeping would not contribute adversely to existing or reasonably foreseeable future sediment impacts.

The effect of the Proposed Action with Modified Exclusion Areas combined with foreseeable future actions also is not expected to differ from existing conditions. Although DCR sweeping of clean stone and limestone would be restricted in nearshore areas and relocated to deeper waters, the additional contribution of this subset of DCR sweeping in deeper waters is not expected to be significant and would not contribute adversely to existing or reasonably foreseeable future sediment impacts.

The effect of the Proposed Action with DCR Control Measures on Ships combined with foreseeable future actions emphasizing control of nonpoint sources to sediments is not expected to be different from current conditions. This alternative is expected to decrease DCR sweeping to varying degrees, and would not contribute adversely to existing or reasonably foreseeable future sediment impacts.

Similarly, the effect of the Proposed Action with Shoreside DCR Control Measures combined with foreseeable future actions emphasizing control of nonpoint sources of sediment is not expected to be different from current conditions and would not contribute adversely to existing or reasonably foreseeable future sediment impacts.

The No Action alternative would not contribute adversely to existing or reasonably foreseeable future sediment impacts. Due to the lack of understanding of invasive mussels we are unable to predict whether a decrease in DCR discharge would reduce their future exacerbation. This is because in areas where there have been historic DCR deposition and mussels have become established, the live and spent mussel shells could continue to provide suitable substrate for invasive mussels. Therefore a reduction of DCR is not necessarily considered beneficial for this resource area.

5.3.2 Water Quality

As described above, the Proposed Action would be a continuation of existing conditions with the addition of recordkeeping. The cumulative effect of the Proposed Action, which does not have a water quality impact, combined with foreseeable future actions emphasizing ongoing water quality improvements is not expected to be different from present conditions and would not contribute to existing or reasonably foreseeable future water quality degradation.

The Proposed Action with Modified Exclusion Areas does not affect water quality nor would this alternative contribute to any existing or reasonably foreseeable future water quality degradation. Clean stone and limestone do not result in documented water quality impacts, and the relocation of their sweepings combined with ongoing water quality improvements is not expected to be significant. Therefore, this alternative would not contribute to existing or reasonably foreseeable future water quality degradation.

Similarly, the effect of the Proposed Action with DCR Control Measures on Ships and the Proposed Action with Shoreside DCR Control Measures combined with foreseeable future actions emphasizing water quality improvements is not expected to be different from current conditions. These alternatives do not have an additive impact on water quality and are not expected to have a cumulative impact when considered with other foreseeable actions affecting water quality.

The No Action alternative would not contribute adversely to existing or reasonably foreseeable future water quality impacts.

5.3.3 Biological Resources

As described in Chapter 4, Environmental Consequences, the change in physical structure of the sediment by the addition of DCR creates a substrate that is more conducive to invasive mussel attachment. Thus, there is the potential impact of increased invasive mussel density or distribution. The Proposed Action would be a continuation of existing conditions with the addition of recordkeeping. The effect of the Proposed Action combined with foreseeable future actions emphasizing water quality improvements, control of sediment contributions to the Great Lakes, and control of invasive mussels is not expected to be different from existing conditions and would not contribute to existing or reasonably foreseeable future changes in biological resources. DCR sweepings occur over a relatively small area, and in most areas, the presence or density of mussels is already either near the maximum or limited by factors unrelated to DCR (for example, calcium, food, depth, and temperature). However, if long-term future changes in conditions (such as increased calcium levels, increased temperatures, or increased food supplies) create conditions conducive to mussel attachment, the continued sweeping of DCR would provide suitable substrate, and mussels could invade areas where they are not currently present or occur only at low densities.

The effect of the Proposed Action with Modified Exclusion Areas combined with foreseeable future actions also is not expected to be different from existing conditions and would not contribute to existing or reasonably foreseeable future changes in biological resources. Although clean stone and limestone sweeping would be relocated from nearshore to deeper water areas, and future actions would emphasize water quality improvements, control of sediment contributions to the Great Lakes, and control of invasive mussels, existing mussel shells would continue to serve as substrate and in some areas suitable habitat would continue to serve as suitable attachment sites

Neither the effect of the Proposed Action with DCR Control Measures on Ships combined with foreseeable future actions nor the effect of the Proposed Action with Shoreside DCR Control Measures combined with foreseeable future actions is expected to be different from existing conditions and would not contribute to existing or reasonably foreseeable future changes in biological resources. As with the Proposed Action, DCR sweepings occur over a relatively small area, and in most areas where mussels are present, their density already is either near the maximum or limited by factors unrelated to DCR (for example, calcium, food, depth, and temperature).

The No Action alternative would not contribute adversely to existing or reasonably foreseeable future impacts to biological resources.

5.3.4 Socioeconomic Resources

The Proposed Action would be a continuation of existing conditions with the addition of recordkeeping. The effect of the Proposed Action combined with foreseeable future actions emphasizing the cost and competitive factors for the waterborne dry bulk carrier industry and related industries is expected to be similar to, or perhaps slightly more intense than the existing conditions, due to higher operating costs (primarily fuel) for ships, decreased efficiencies from light loading in response to lower lake levels, and possibly greater competition from other modes. Fishing and environmental justice are expected to be similar to the current state.

The effect of the Proposed Action with Modified Exclusion Areas combined with foreseeable future actions is expected to differ little from existing conditions, in the manner described in the previous paragraph.

The cost impact of the Proposed Action with DCR Control Measures on Ships combined with foreseeable future actions emphasizing the cost and competitive factors for the waterborne dry bulk carrier industry and related industries is expected to be somewhat more than existing conditions, for shipping. Again, this is due to higher operating costs, decreased efficiencies from light loading, and possibly greater competition from other modes. The economic impact could be greater due to the costs of control measures on top of the other costs. Fishing and environmental justice are expected to be similar to the current state.

The effect of the Proposed Action with Shoreside DCR Control Measures combined with foreseeable future actions emphasizing the cost and competitive factors for shore facilities that handle dry bulk cargos is expected to be somewhat stronger than the existing conditions, due to higher operating costs (primarily energy), and possibly greater competition with facilities for other transportation modes. Fishing and environmental justice are expected to be similar to the current state.

5.4 Mitigation Measures

5.4.1 Introduction

In the context of NEPA, mitigation includes the following:

- Avoiding an impact by not taking a certain action or parts of an action
- Minimizing an impact by limiting an action in some way
- Rectifying an impact by rehabilitating or restoring the affected environment
- Compensating for an impact by replacing the affected resources

Although DCR sweepings do not result in significant impacts to the sediment quality, water quality, or biological resources of the Great Lakes, insignificant effects to the physical structure of the sediment, the benthic community, protected and sensitive areas, and invasive species are predicted for some alternatives. Insignificant impacts to physical structure of the sediment, the benthic community, and invasive species could only be mitigated by reducing DCR sweeping. By definition, each of the alternatives under consideration in this EIS minimizes or otherwise restricts DCR sweeping to varying degrees. Although management measures (i.e. ship and shoreside DCR control measures) were considered independently to facilitate their evaluation and comparison, they could be combined to further minimize DCR sweeping and thus mitigate impacts. Combining management measures (and alternatives) will depend on an evaluation of the relative benefit and cost of applying additional control measures to the selected alternative, as well as evaluating possible duplication and conflicts between different control measures and alternatives.

5.4.2 Mitigation for Protected and Sensitive Areas

As described in Chapter 4, each alternative (except No Action) results in an insignificant impact to protected and sensitive areas because discharges are allowed within these areas (Table 4-5). The impacts are not significant because they were not judged to adversely affect or alter the resources within the areas. However, allowing DCR discharge was considered an insignificant impact because the possibility (but not the probability) exists that at some time, possibly due to an unusual event (such as adverse weather or navigation issues) a minor impact could occur if there is any discharge in the protected or sensitive area. The insignificant impacts to protected and sensitive areas can be mitigated by prohibiting discharges and there by virtually eliminating the possibility of an impact to the areas as discussed below. This would not interrupt the conservation and management efforts in these areas

For three of the Designated or Managed Areas (Isle Royale National Park, Detroit River NWR and Northern Refuge, shallow reefs near Beaver Island) the only sweeping allowed is limestone and clean stone. In each of these areas the prohibition of limestone and clean stone within the boundaries of the areas would mitigate the impact from insignificant to no impact. This restriction would not require delays, rerouting or other alterations of ship operation because the track lines extend well beyond the protected areas and DCR sweeping and sweeping could occur once the ships cleared the areas. Thus there would be no increased costs or economic impacts to the shipping industry resulting from the prohibition.

Any of the above mitigation option could apply to any of the following alternatives: Proposed Action, Proposed Action with DCR Control Measures on Ships and Proposed Action with Shoreside DCR Control Measures.

Sweeping of limestone and clean stone are allowed anywhere within one of the Designated or Managed Areas (Thunder Bay NMS) and sweeping of other types of DCR are allowed beyond 12 miles from shore within the sanctuary. The impact to this area can be mitigated by prohibiting the sweeping of limestone and clean stone, and other types of DCR beyond 12 miles to the boundary of the sanctuary. Similar to the other Designated or Managed Areas discussed above, this restriction would not require delays, rerouting or other alterations of ship operation because the track lines extend well beyond the protected areas and DCR sweeping could occur once the ships cleared the area. Thus there would be no increased costs or economic impacts to the shipping industry resulting from the prohibition. This applies to the Proposed Action, Proposed Action with DCR Control Measures on Ships and Proposed Action with Shoreside DCR Control Measures.

There are two Other Sensitive Habitats (Green Bay and Western Basin of Lake Erie) with insignificant impacts to protected and sensitive areas (Table 4-5). Sweeping of limestone and clean stone is allowed anywhere in Green Bay, which results in a classification of insignificant impact. The impact to this area can be mitigated by limiting the sweeping of limestone and clean stone within the areas to ships loading and unloading in Green Bay. Prohibition of sweeping for ships traveling exclusively within Green Bay would force them to make significant detours and delays which would have significant economic impacts. Even though it would be allowed, little or no sweeping of limestone and clean stone would be expected because at least in 1999 none of this material was loaded and unloaded in Green Bay (USCG 2002). The impact for Green Bay would remain as insignificant after mitigation but it would be less than without mitigation. Similar to the other Designated or Managed Areas discussed above, this restriction would not require delays, rerouting or other alterations of ship operation because the track lines extend well beyond the protected areas and DCR sweeping could occur once the ships cleared the area. Thus there would be no increased costs or economic impacts to the shipping industry resulting from the prohibition. This applies to the Proposed Action, Proposed Action with DCR Control Measures on Ships and Proposed Action with Shoreside DCR Control Measures.

There are two types of sweeping allowed in the Western Basin of Lake Erie under all but the No Action Alternative:

- Sweeping of limestone and clean stone anywhere
- Sweeping of coal, taconite and salt within dredged channels for ships carrying cargo within the Western Basin of Lake Erie

The impact for the Proposed Action, Proposed Action with DCR Control Measures on Ships and Proposed Action with Shoreside DCR Control Measures can be mitigated by preventing the sweeping of limestone and clean stone from ships not carrying cargo exclusively within the Western Basin of Lake Erie. The insignificant impact resulting from ships loading and unloading in the Western Basin sweeping coal, taconite, and salt, in dredged channels (all alternatives but No Action) can not be mitigated without significant economic impact to the shipping industry. Requiring ships carrying cargo among ports in the Western Basin to detour out of the basin to clear the decks and tunnels of DCR would make the operation less economical, thus they would be inconsistent with the purpose and need for this action. Consequently, although the insignificant impact to the Western Basin can be mitigated by limiting the sweeping of limestone and clean stone to ships loading and unloading in the Western Basin, there still remains an insignificant impact.

Implementation of the mitigation measures discussed above would greatly lessen the impact to protected and sensitive areas. However, because the minor impact resulting from sweeping into the dredged channels in the Western Basin of Lake Erie (only by ships transporting cargo exclusively with the basin) and limestone and clean stone in the Western Basin and Green Bay (also only by ships transporting exclusively within the areas) can not be mitigated, the impact to protected and sensitive areas is still classified as insignificant for all alternatives except No Action. However, the impacts would be measurably reduced and the impacts with the mitigation are assigned an impact between no impact and insignificant impact to contrast them with the impacts of the alternatives without mitigation.

CHAPTER 6

Permits, Licenses, and Approvals

This section discusses potential permitting requirements and approvals associated with each of the alternatives under consideration. As discussed in Chapter 1, the Coast Guard and Maritime Transportation Act of 2004, Public Law 108-293, § 623, stipulates that the current policy for regulating sweepings expire not later than September 2008, mandates that the Coast Guard conduct this environmental review in support of decision-making on potential regulations, and gives the Coast Guard regulatory authority over the sweeping of DCR, notwithstanding any other law. It is not anticipated that the Coast Guard would require permits for alternatives that would allow the continued sweeping of DCR. Currently, Coast Guard is not aware of any Great Lakes state permitting requirements for DCR.

6.1 No Action Alternative

Under the No Action alternative, DCR would be removed from a ship's deck and tunnel, collected, and not swept directly to waters of the United States. The residue from the deck would be returned to the ship's hold or the dockside dry cargo storage area. The tunnel-washing residue and water would be transported by pump system to shoreside facilities, where it would be pretreated for solids removal and then conveyed to a municipal wastewater treatment plant for final treatment.

Construction of a pretreatment facility could require several permits. A pretreatment permit would be required to sweep the pretreated tunnel and deck washwater to the municipal treatment plant; the port at which the pretreatment facility is sited is likely to require a modification to its stormwater discharge permit; and local construction permits and approvals may be required by the city or municipality within which the port is located, including approval to connect to the municipal sewer system. An approved residuals discharge plan detailing disposal of wastewater solids would be required also. Air permits are not expected to be required for a treatment process that is only separating solids.

Ship modifications require Coast Guard review. Therefore Coast Guard approval of pump and piping system modifications needed to transport the washwater from the ship to the treatment facility would be required.

6.2 Proposed Action (IEP as Coast Guard Regulation with Recordkeeping)

Under the Proposed Action, recordkeeping of all DCR sweeping activities would be required. Although a permit would not be necessary, Coast Guard review of monitoring records would be necessary. No permits are anticipated.

6.3 Proposed Action with Modified Exclusion Areas

The Proposed Action with Modified Exclusion Areas is not expected to require permits or approvals beyond Coast Guard review of recordkeeping.

6.4 Proposed Action with DCR Control Measures on Ships

The Proposed Action with DCR Control Measures on Ships is not expected to require permits or approvals beyond Coast Guard review of recordkeeping.

6.5 Proposed Action with Shoreside DCR Control Measures

Permits may or may not be required under this alternative, depending on the type of control measures that are implemented at a port facility. If the measures are operational, it is unlikely permits would be required. Structural changes or modifications that affect impervious area and stormwater runoff would likely require local construction permits and stormwater management permit modifications.

CHAPTER 7

Comparison of Alternatives

7.1 Introduction

The impacts of each alternative are described in Chapter 4. The impacts of the Proposed Action (IEP as Coast Guard Regulation with Recordkeeping) are presented largely in comparison to impacts measured after decades of DCR sweeping at locations and rates similar to estimated DCR sweepings under the Proposed Action. Impacts of other alternatives are presented in Chapter 4 in relation to the Proposed Action impacts based on changes in DCR management practices of the other alternatives. This chapter also compares the impacts of each alternative to the impact of No Action, where the IEP expires and DCR sweeping to waters of the U.S. is prohibited. Under the No Action alternative, DCR is assumed to be managed by clearing and disposing of DCR while the ship is in port without discharging to the water.

7.2 Basis for Comparison

The impact analysis is structured around significance criteria, so that impacts can be uniformly categorized as having “No Impact,” an “Insignificant Impact,” or a “Significant Impact.” This greatly aids in the comparison of alternatives because impacts to different resources (for example, sediment, water quality, and biota) can be viewed on a common basis. The criteria are described in detail in Chapter 4 and summarized in Table 7-1.

TABLE 7-1
Significance Criteria

Resource Category	No Impact	Insignificant Impact	Significant Impact
Sediment Quality			
Sediment chemistry	Concentrations under threshold or reference	Concentrations under probable effects	Concentrations over probable effects
Physical structure	Grain size similar to reference	Grain size different than reference, but no benthic habitat degradation	Benthic habitat degradation
DCR deposition rate	DCR rate within range of background	DCR and natural rates no more than 10% greater than maximum natural rate	DCR and natural rates over 10% greater than maximum natural rate
Water Quality			
Water chemistry	Concentrations under GLI chronic values	Outside of mixing zone concentrations under GLI chronic values	Outside of mixing zone concentrations over GLI chronic values
Nutrient enrichment	No substantial change in algal growth compared to reference	No substantial change in algal growth outside mixing zone compared to reference	Substantial change in algal growth outside mixing zone compared to reference

TABLE 7-1
Significance Criteria

Resource Category	No Impact	Insignificant Impact	Significant Impact
Dissolved oxygen	No increase in oxygen demand	No increase in oxygen demand outside mixing zone	Increase in oxygen demand outside mixing zone
Biological Resources			
Special status species	No special status species present or no interaction between DCR and species	Interaction between DCR and special status species, but no effects on individuals, populations or habitat	Continued existence of any special status species jeopardized or adverse changes to habitat of species
Protected and sensitive areas	No areas present in sweeping areas	Areas present but no alteration	Alteration of areas
Benthic community	No difference in structure or toxicity compared to Reference	Differs from reference but no degradation; no acute effects	Degradation or acute effects
Fish and other pelagic/planktonic organisms	No water quality or toxicity effects	No water quality or toxicity effects outside of mixing zone	Water quality or toxicity effects outside of mixing zone
Invasive species	Factors other than substrate limit mussel distribution, maximum mussel population capacity already achieved, or no preferential mussel attachment to DCR at anticipated density compared to native soft sediment	Preferential mussel attachment to DCR at anticipated density is less than 10% greater than native soft sediment	Preferential mussel attachment to DCR at anticipated density is more than 10% greater than native soft sediment
Waterfowl	No elevated prey species tissue concentrations	Elevated prey species tissue concentrations but below effects levels	Elevated prey species tissue concentrations above effects levels
Socioeconomic Resources			
Economic systems (waterborne dry bulk cargo shipping, or industries that depend directly on waterborne shipping) and Water-dependent infrastructure	DCR management practices do not affect efficiency of shipping. Negligible economic costs.	DCR management practices minimally affect efficiency of shipping. Minor economic costs.	DCR management practices substantially affect efficiency of shipping. Major economic costs.
Fishing	Same as that for Fish and other pelagic/planktonic organisms, under ***Biological Resources*** above.		

TABLE 7-1
Significance Criteria

Resource Category	No Impact	Insignificant Impact	Significant Impact
Environmental justice	DCR not swept, or minority and/or low-income persons or populations not present or their means of subsistence not in areas within the possible influence of DCR sweeping (fishing), or sweepings occur in area with minority and/or low-income persons or populations but no interaction.	Environmental justice	DCR not swept, or minority and/or low-income persons or populations not present or their means of subsistence not in areas within the possible influence of DCR sweepings (fishing).

The comparison-of-alternatives method selected for use in an EIS depends on the complexity of the impacts and the alternatives. In some complicated cases, a highly structured and quantitative method using sophisticated decision science is suitable because of the nature of available data. In other cases, a qualitative approach is more appropriate, due to more straightforward or less quantitative information. For the DCR rulemaking, both the impacts and the alternatives are straightforward. The impacts are directly related to the location and mass of DCR and the alternatives are different methods of reducing the mass or controlling the location of sweeping. Thus a qualitative basis of comparison is appropriate for this EIS.

7.3 Comparison of Alternatives

All of the alternatives have the same level of impact as the No Action alternative in most resource categories (Chapter 4). The only natural resource areas where the impacts of the alternatives differ from No Action are: sediment physical structure; benthic community structure; sensitive and protected areas; and invasive species. The differences from No Action for three of the resources (i.e. sediment physical structure; benthic community structure; and invasive species) are due to a single factor: the differences in the physical characteristics (for example, size, shape, density, and ratio of mass to surface area) between the DCR particles and the native, soft sediment particles. The more DCR within the surface sediment, the more the substrate is altered. The impact on sensitive and protected areas varies from No Action and is similar for all other alternatives. The insignificant impact in this area arises from allowed sweeping in designated, managed, or sensitive areas, primarily for limestone and clean stone. As discussed below and in Chapter 5, these impacts can be mitigated. Although sweeping is allowed, no adverse impact or alteration of the resource is predicted (Chapter 4). The level of socioeconomic impact also varies among alternatives. A comparison of each alternative to the No Action alternative is presented below for each of these resources. The comparison of impacts for each alternative, taking into account mitigation where applicable is described below for the resources areas where impacts are expected and summarized in Table 7-2.

TABLE 7-2
Comparison of Alternatives Based on Significance Criteria

Resource Category	No Action	Proposed Action—Coast Guard Preferred Alternative		Modified Exclusion Areas	DCR Control Measures			
		Without Mitigation	With Mitigation		Ship	Ship with Mitigation	Shore	Shore with Mitigation
Sediment Quality								
Sediment chemistry	○	○	○	○	○	○	○	○
Sediment physical structure	○	●	●	●	●	●	●	●
DCR deposition rate	○	○	○	○	○	○	○	○
Water Quality								
Water chemistry	○	○	○	○	○	○	○	○
Dissolved oxygen	○	○	○	○	○	○	○	○
Nutrient enrichment	○	○	○	○	○	○	○	○
Biological Resources								
Special-status species	○	○	○	○	○	○	○	○
Protected and sensitive areas	○	●	◌	◌	●	◌	●	◌
Benthic community	○	●	●	●	●	●	●	●
Fish, other pelagic organisms	○	○	○	○	○	○	○	○
Invasive species—Lake Ontario, Lake Erie, Lake Superior	○	○	○	○	○	○	○	○
Invasive species—Lake Michigan, Lake Huron	○	●	●	●	●	●	●	●
Waterfowl	○	○	○	○	○	○	○	○

TABLE 7-2
Comparison of Alternatives Based on Significance Criteria

		Proposed Action—Coast Guard Preferred Alternative			DCR Control Measures			
Resource Category	**No Action**	**Without Mitigation**	**With Mitigation**	**Modified Exclusion Areas**	**Ship**	**Ship with Mitigation**	**Shore**	**Shore with Mitigation**
Socioeconomic Resources								
Economic systems—dry bulk carrier industry	●	○	○	◍	◍	◍	◍	◍
Economic systems—industries dependent on great lakes waterborne dry bulk shipping	●	○	○	○	○	○	○	○
Water-dependent infrastructure—commercial shipping lanes	○	○	○	○	○	○	○	○
Water-dependent infrastructure—port facilities	●	○	○	○	○	○	◍	◍
Fishing—recreational and commercial	○	○	○	○	○	○	○	○
Environmental justice	○	○	○	○	○	○	○	○

○ No adverse impact.
◌ Impact, but impact less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

7.3.1 Sediment Physical Structure

Under the Proposed Action, the amount of DCR in the surface sediment will be essentially the same as what currently exists. There could be reductions compared to existing conditions that result from more diligent attention to "good housekeeping" prompted by recordkeeping. However, these reductions would be minor, and it is not possible to quantifiably project the amount of reduction that would take place. As described in Chapter 4, in the areas of most intense sweeping, DCR could make up as much as 0.2 percent of the sediment. Thus, compared to No Action, there could be slightly more large or dense material in the sediment in these areas, which would have only an insignificant impact on sediment physical structure.

This insignificant impact, compared to No Action, would not be immediate. Since sediment mixing through currents, movement of the nepheloid layer, and biological action occur over most of the lake bottom, DCR is continually migrating through the sediment, sometimes being buried and sometimes brought closer to the surface. These processes most likely produce a steady state as long as DCR is continually deposited. But were the deposition halted under the No Action alternative, burial would eventually dominate the process, and DCR would gradually decrease as a component of the sediment. As described in Chapter 4, based on natural sedimentation rates and other processes, this permanent burial would take years and perhaps decades, so no change in sediment physical structure would occur in the short term.

In the offshore (over 3 statute miles from the coast) waters of the Great Lakes, the Proposed Action with Modified Exclusion Area alternative would have similar impacts as the Proposed Action. The impacts would not be identical because there would be a very small increase in the deposition of limestone and clean stone in offshore areas because it would no longer be swept nearshore. In selected nearshore waters where sweeping of limestone DCR occurs, the Proposed Action with Modified Exclusion Area alternative would have an impact similar to No Action because there would be no sweeping in the nearshore waters. The effect in the nearshore would be realized for both the No Action and the Modified Exclusion Area alternatives in just a few years (approximately 4 to 6) because natural deposition rates are higher in nearshore areas, and previously deposited limestone would likely be covered in this time period.

The impacts on sediment physical structure for the two DCR Control Measures alternatives (ship and shore) would be very similar. As described in Chapter 4, both of these alternatives would reduce the mass of DCR swept by as much as 40 percent and therefore reduce the mass of DCR incorporated into surface sediments. Thus in the long-term, compared to No Action, the amount of DCR in surface sediments could be up to 40 percent less than the current 0.2 percent. There would still be a lag period for the change to be realized, but the time required for a reduction in percent DCR in surface sediments to be realized would be less than for the Proposed Action because less DCR would be deposited.

There is, particularly for the ship and shore DCR Control Measure alternatives, a high degree of uncertainty regarding the decrease in DCR that can be achieved. This is true in aggregate and with respect to individual control measures. Since the reduction in DCR resulting from these alternatives is uncertain, the change in impact from existing conditions and No Action is equally uncertain.

7.3.2 Protected and Sensitive Areas

The predicted impacts on this resource are insignificant and result from the allowed sweeping of DCR in several areas considered designated, managed, or sensitive (Table 4-5). The impacts would be substantially less for the Modified Exclusion Areas alternative than for the other action alternatives because DCR swept into protected and sensitive areas would only be: limestone and clean stone to the Western Basin of Lake Erie and Green Bay (only ships loading and unloading within the areas); coal, taconite, and salt in the dredged channels of the Western Basin of Lake Erie; and limestone and clean stone to Green Bay in Lake Michigan. Allowed sweeping in all of these areas are limited to ships transporting dry cargo totally within the area and thus the ships can not sweep DCR outside the area during transit.

The Proposed Action and the Proposed Action with ship and shoreside DCR control measures allow sweeping in the same areas as the modified exclusion area alternative plus additional protected and sensitive areas. These alternatives also allow sweeping of limestone and clean stone in Isle Royale National Park, Thunder Bay NMS, Northern Refuge, shallow reefs near Bear Island, and the Detroit River NWR. In addition, under these alternatives sweeping of other types of DCR would be allowed in the portion of the Thunder Bay NMS beyond the exclusion area. The impacts on these protected and sensitive areas would be greater, than the impacts predicted for the modified exclusion area alternative (Table 7-2).

However, as discussed in Chapter 5, the impacts on protected and sensitive areas can be mitigated for the Proposed Action, Proposed Action with DCR Control Measures on Ships and the Proposed Action with Shoreside DCR Control Measures. The mitigation measures discussed in Chapter 5 would accomplish the same level of protection afforded by the modification of exclusion area alternative. Thus, with mitigation the impacts would be the same for all action alternatives (Table 7-2).

7.3.3 Benthic Community Structure

The changes in sediment physical structure summarized above create a slightly altered benthic habitat and thus have a potential to slightly alter benthic community structure. The degree of alteration is proportionate to the amount of DCR swept; thus compared to No Action, the Proposed Action has the most alteration and impact. However, the Modified Exclusion Area alternative has approximately the same impact as the Proposed Action in offshore waters and the same impact as No Action in nearshore waters. The DCR Control Measure alternatives (ship and shore) have greater impact than No Action but up to 40 percent less impact than the Proposed Action. Even for the Proposed Action, the change compared to No Action is minor, over only a small area, and thus is categorized as insignificant. Also, for all alternatives the change to community structure is not a degradation of the resource; rather, it is a minor shift from the structure in reference areas.

7.3.4 Invasive Species

As discussed in Chapter 4, invasive mussels are ubiquitous in Lake Erie (Ciborowski, 2007) and Lake Ontario (Maher, 1999). Lake Superior lacks a large mussel invasion due to low calcium levels (not substrate) limiting production (Jenson, 2007; AP, 2007). Thus Lake Erie, Lake Ontario, and Lake Superior would experience no impact from invasive mussels under any alternative considered. The remaining alternatives discussion on invasive species will be in reference to Lake Huron and Lake Michigan.

The change in physical structure of the sediment by DCR addition (as described above) also may create a substrate that is more conducive to invasive mussel attachment. Thus there is the potential impact of increased invasive mussel density or distribution. There is no impact on invasive species for the No Action alternative because over time the existing DCR would be covered by natural processes, and increased mussel attachment habitat would decrease. However, existing mussel shells would continue to serve as substrate and thus as suitable attachment sites. As discussed above, the reduction of impact could take decades.

Under the Proposed Action, compared to no action, Lakes Michigan and Huron would be affected by invasive mussels because DCR would continue to be swept and could increase habitat availability. In many areas of these lakes where there are no invasive mussels, factors other than lack of attachment sites (for example, food availability, predation, and calcium concentrations) limit mussel density and distribution. In these areas, the impact of the Proposed Action on invasive mussels would be the same as the impact of No Action. In other areas, mussel densities may be limited by substrate attachment sites, and in the short term the Proposed Action would have greater impact than the No Action alternative.

The areas where a difference between No Action and the Proposed Action impacts would be realized for invasive species are limited. Thus, the impact from the Proposed Action is not considered significant because it is over a small area and, in most areas, the presence or density of mussels is already either near the maximum or limited by factors unrelated to DCR (for example, calcium, food, depth, and temperature). Also, since DCR has been swept for over a century, and since it would likely take at least 10 years for the existing DCR to be buried (see Chapter 4), the continued practice is not expected to produce a change, compared to No Action, over the short term. Similarly, over the short term the continued deposition of DCR at current rates is not expected to increase mussel density or distribution to the point of affecting ecosystem resources or processes.

Over the long term (greater than 10 years), it is possible that other factors controlling mussel distribution or density (for example, food supply or calcium concentrations, or species adaptation to depth) could change from activities such as anthropogenic-increased enrichment or climate change. If these changes did result in reduced impacts from the other factor(s), the density of DCR in the sediment could become a limiting factor in some areas. If these conditions materialized in the long term, then compared to No Action, the Proposed Action could result in an increased density and/or distribution of invasive mussels.

The Modified Exclusion Area alternative would have an effect on invasive mussels similar to that of the No Action alternative in nearshore waters (because limestone and clean stone sweepings would be decreased), but in Lakes Michigan and Huron, the alternative would have an insignificant impact in offshore waters, similar to the Proposed Action. The DCR Control Alternatives (ship and shore) decrease, to some degree, the mass of DCR swept, and compared to the Proposed Action, the impact to invasive mussels would be decreased proportionately. Thus there would still be an increased impact compared to No Action in Lakes Michigan and Huron but less than that of the Proposed Action.

7.3.5 Socioeconomics

The only natural resource areas where the impacts of the alternatives differ from No Action are for sediment physical structure, benthic community structure, and invasive species. This is due to a single factor: the differences in the physical characteristics (for example, size, shape, density, and ratio of mass to surface area) between the DCR particles and the native, soft sediment particles. The more DCR within the surface sediment, the more the substrate is altered. The level of socioeconomic impact also varies among alternatives.

The socioeconomic resource areas where the impacts of the alternatives differ from No Action are the economic systems and water-dependent infrastructure. This is due to the potential economic cost to the dry bulk carrier industry and port facilities to install and operate DCR Control Measures.

A comparison of each alternative to the No Action alternative is presented below for each of these resources.

7.3.6 Economic Systems and Water-Dependent Infrastructure

Under the Proposed Action, the efficiency of shipping (economic systems) and port facilities (water-dependent infrastructure) will remain essentially the same as what currently exists and the estimated economic costs would be negligible, consisting of the minimal time and cost involved in recordkeeping by the shipping companies and in making those records available to inspectors.

The Proposed Action with Modified Exclusion Areas alternative would have similar impacts as the Proposed Action. The impacts would not be identical because a minor increase in economic costs may occur to shipping if some ships have to deviate from their customary routes to sweep.

The impacts of the Proposed Action with DCR Control Measures on Ships alternative would be similar to the Proposed Action. Impacts to efficiencies of ships from having to operate and maintain control measures could be slightly greater than under the Proposed Action, but still in the no impact category. Estimated economic costs to shipping would be higher, consisting of recordkeeping, and installation and operation of control measures for those ships that did not already have them. The costs for ship or shore DCR control measures are highly uncertain, although they are anticipated to be minor, hence the effects on economic systems are classified as insignificant impact.

The impacts of the Proposed Action with Shoreside DCR Control Measures alternative would be similar to those of the Proposed Action with DCR Control Measures on Ships alternative. Here the impact would focus on port facilities, and their estimated economic costs would be higher than for the Proposed Action, for those facilities that had to install and operate new control measures. Estimated economic costs to shipping might be higher, depending on how much of any additional costs to shore facilities that could be transferred to ships. Again, the costs for ship or shore DCR control measure are highly uncertain, although they are anticipated to be minor, and the effects on economic systems are considered as insignificant impact.

The impacts of the No Action alternative would be major (significant) for the efficiency and cost of shipping and industries directly dependent on Great Lakes waterborne dry bulk shipping (economic systems) and port facilities (water-dependent infrastructure). The impacts would be the additional time (delay) at the facilities for vessels to collect DCR and the costs for vessel delay, labor to collect DCR, shipboard systems to convey DCR and washwater to shore facilities, shore facility pretreatment systems, and sewer usage charges for disposing of washwater to municipal wastewater systems.

7.4 Summary of Comparison

All alternatives would have slightly greater impact on the three resource areas related to sediment (sediment physical structure, benthic community structure, and invasive species) compared to No Action, but No Action would have a greater socioeconomic impact. For sediment physical structure and benthic community structure, the impacts are not degradation, but rather a change compared to reference sites. For invasive species, the impact would occur only in Lakes Michigan and Huron and is considered minor, at least in the short term. The intensity of impacts on these resources would differ among alternatives but the quantification of the differences is highly uncertain because the effectiveness of DCR control measures is difficult to determine. There would be differences in the economic impacts of alternatives, but quantification of the differences is similarly highly uncertain. Because of the uncertainty in effectiveness and costs of DCR control measures, the Coast Guard's preferred alternative at this time is Alternative 2, the IEP with recordkeeping on DCR control measures. This alternative will assist the Coast Guard in collecting additional cost, benefit, and effectiveness information on DCR control measures for possible future rulemaking.

CHAPTER 8

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CHAPTER 9

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